THE OPTIMAL VOLUNTARY WAITING PERIOD FOR INSEMINATION OF POSTPARTUM DAIRY COWS UNDER VARYING CIRCUMSTANCES

C.Inchaisri[1,2], R.Jorritsma[1], P.L.A.M.Vos[1], G.C. van der Weijden[1], H.Hogeveen[1,3]

[1]: Department of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, Utrecht, The Netherlands
[2]:Department of Veterinary Medicine, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, Thailand
[3]:Chair group Business Economics, Wageningen University, Wageningen, The Netherlands

1. INTRODUCTION

An important managerial aspect of fertility is the voluntary waiting period (VWP), defined as the moment in weeks post-partum (wks pp) in early lactation after which farmers start to inseminate their cows. It is observed that farmers select a longer VWP and thus a longer calving interval (CI) for higher producing cows. They state that it is economically feasible to do so and suggests that the generally advised CI of 365 days is in practice not regarded optimal. As it is very difficult to evaluate with field data whether the suggestion that a longer CI is profitable or not is true, we created a Monte-Carlo stochastic simulation model to calculate the economic effects of different VWP's. The simulation model allowed for calculation of the economic effect of postponing the VWP, using varying cow factors and economic values that occur in the Netherlands.

2. MATERIALS AND METHODS

A Monte-Carlo stochastic simulation model was created to calculate the economic effects of non-optimal fertility in dairy cattle. The model is dynamic and uses time steps of one week to simulate the reproductive cycle, the occurrence of postpartum disorders and milk production. These variables of interest were varied randomly, based upon relevant distributions. Included factors of interest were: parity (1-5), timing of the first ovulation (between 1-10 wks pp), ovulation rate (fixed at 0.95), estrus detection rate (between 0.3-0.7), conception rate (between 0.3-0.7), gestation period (between 38-42 wks), milk production level (between 5200-10700 kg/305 days), milk persistency (represented by factor B and C in Wood's curve and varying between 0.012-0.0562), time to peak milk production (between 4-8 wks pp), milk production loss due to gestation (between 0.26-4.32 kg/week depending on gestation period) (Olori et al., 1997), incidence rate of postpartum disorders reducing ovulation rate (between 0.03-0.11) (Hooijer et al., 1999) and time of disorder occurrence (between 6-14 wks pp), incidence rate of postpartum disorder reducing conception rate (between 0.20-0.33) (Loeffler et al., 1999) and late embryonic death rate (between 0.05-0.09) (Silke et al., 2002). The economic values in the analysis were milk price (between €0.07-0.20 per kg), calf price (between €50-200 per calf), insemination cost (between €7-24 per insemination), calving cost (between €137-167 per calving, including costs for diseases associated with calving) and culling costs, expressed as the retention pay-off (between €-1479-261) (Houben et al., 1994). The culling costs depended on parity and the level of milk production of that cow. Known interactions between e.g. milk production and fertility were included in the model.

Each simulation was made up of 100,000 iterations. For each iteration, the economic effect VWP's varying from 7 to 15 wks pp was calculated. The average economic losses, when comparing the extended VWP with a VWP of 6 wks, was calculated. Per iteration, the VWP with the minimum of economic loss or the maximum profit was determined.

Comparison in the cumulative distribution function with VWP of 6 wks, the possible options for the decision makers who prefer the higher economic value was determined by the first-degree stochastic dominance analysis and for who prefer to reduce the risk of economic losses was determined by the second-degree stochastic dominance analysis (Olynk and Wolf, 2009).

3. RESULTS

In the first-degree dominance analysis (Figure 2), it's clear that VWP of 6 wks is optimal for 47% of cows and therefore a longer CI is optimal for the other cows. The optimal VWP of most cows (95%) was earlier than 10 weeks (Figure 1). For only 5 % of the iterations, a VWP extended beyond 10 weeks pp was optimal. Every VWP longer than 6 weeks gives, on average, economic losses. For instance, the average annual net economic losses of a VWP of 7 weeks are €3.80 per cow, while for 27 % of the cows, a VWP of 7 weeks is optimal. A VWP of 15 weeks for only 0.07% is optimal and is associated with, on average, €75.11 net annual economic losses per cow. For decision maker who prefer to diminish the risk of economic losses, no others VWP in the second-degree stochastic analysis were better than VWP at 6 wks (Figure 2).

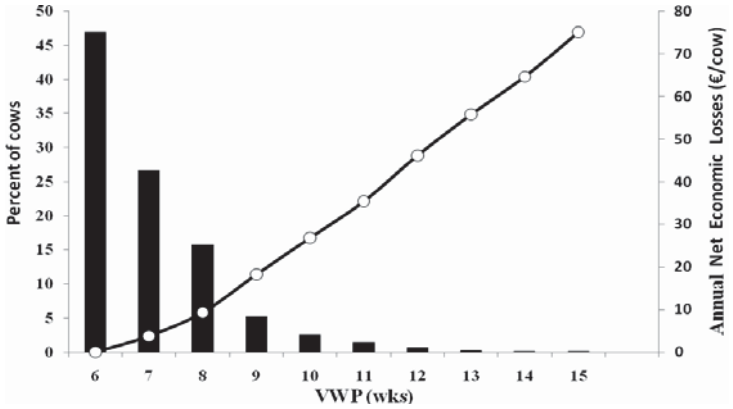

Figure 1. Frequency distribution of economically optimal voluntary waiting period (VWP) (bar graph, left axis) and average annual net economic losses (€/cow) for different VWP relative to a VWP of 6 weeks (line graph, right axis)

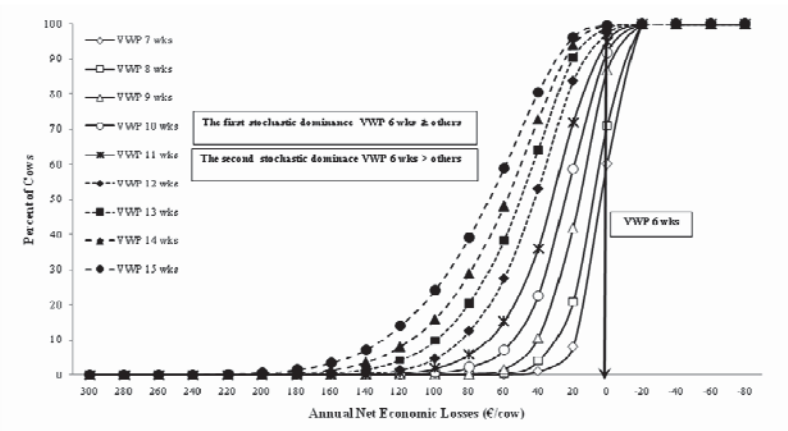

Figure 2. Cumulative density function comparing the annual economic losses of other VWPs with VWP 6 wks

4. DISCUSSION

In conclusion, the optimal VWP varied depending on cow factors and economic values. For most cows, the optimal VWP was shorter than 10 wks pp. However, in some specific circumstances, a VWP longer than 10 wks pp is economically optimal. For farmers who prefer to reduce the risk of economic losses and who do not want to differentiate between cows with regard to the VWP, application of a VWP of 6 wks is optimal. As a next step in this research, it is interesting to further explore the specific circumstances that determine for which cows an extension of the VWP is economically profitable.

5. REFERENCES

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