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Economic Benefits Models relevant to Step 3 in the Herd Assessment Pack tools

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How much is improved reproductive performance worth?

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Achieving target levels of reproductive performance allows farmers to benefit in multiple ways as described in the ***InCalf Book*** Chapter 3: 'What are the benefits of improved reproductive performance?' Not all of these farmer-perceived benefits can be easily valued in economic terms. Those that contribute to overall reproductive performance, defined by InCalf as the **6-week in-calf rate** and **empty rate,** are reflected as accurately as possible in the InCalf Economic Model.

How is the value of changing the 6-week in-calf rate (%) estimated?

The DairyNZ Whole Farm Model (WFM) was used to derive the incremental value of improving 6-week in-calf rate. The WFM predicts reproductive outcomes of individual cows through a deterministic approach based on the scientifically accepted physiological events required for a cow to reestablish a viable pregnancy while lactating. The user can variably set many of the physiological inputs (e.g. oestrus detection efficiency, conception rate, embryonic loss rate, etc) that influence reproductive status at cow level. At the end of each simulation the individual cow outcomes are collated for reporting numerous KPIs at the herd level (eg. 6-week in-calf rate).

A key feature of the WFM is that it predicts the operating profit (EFS, $/ha) for the conditions simulated. This feature allows the associations between variance in reproductive performance to economic outcomes to be explored (within the whole farm system context). The WFM can report EFS in two ways: unadjusted or adjusted. The latter was used in the InCalf Economic Benefits Models. Adjusted EFS accounts for value of acquired (or depleted) average pasture cover, feed stores and cow condition at the end of the simulation (31 May).

The value of the 6-week in-calf rate was estimated by simulating 6 different farms. These were real commercial farms and the WFM had previously been validated against each of them. Validation involved configuring the WFM to predict (to within ± 10% of the KPI value) the 'observed' reproductive and productive KPIs measured on-farm. These details are presented in the *Proceedings of the Dairy Cattle Veterinarians Conference*, Palmerston North, 18-20 June, 2008.

In all, 66 simulations were performed, 11 for each of the 6 farms. Compared to the base situation the simulations explored "what if": Cows started cycling 7 days earlier or later? Oestrous detection was 10% better or poorer? Conception rate was 10% better or poorer? Maintenance of pregnancy was 10% better or poorer? All five factors were simultaneously better or poorer?

The initial estimate of the association between 6-week in-calf rate and operating profit is depicted in Fig.1. A quadratic relationship best descried this association with bigger gains to be made when the 6 week in-calf was poor (e.g. below 60%) and diminishing benefits per % change as this KPI approached maximum.

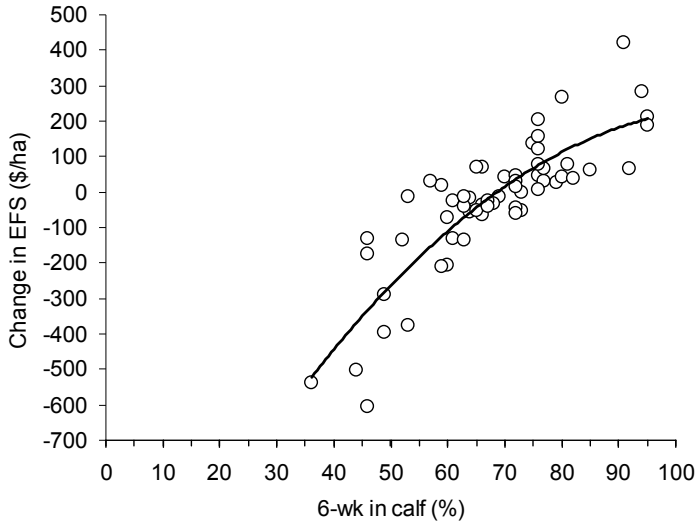

Figure 1. Original modelled relationship between operating profit (adjusted EFS $/ha) and the 6-week in-calf rate.

While the InCalf Programme was being adapted to New Zealand, it became apparent that: (i) the cost of empties was best separated from the association between operating profit and the 6-week in-calf rate depicted in Fig.1; (ii) a linear relationship had to be assumed to simplify the calculations to a single value (i.e. $4 per % change); and, (iii) the value of the 6-week in-calf rate had become outdated as the payout increased dramatically from the $4 per kgMS that these original simulations were based on.

Outcomes of the revised simulations to serve the InCalf requirements are depicted in Fig. 2. The cost of empties was removed by adjusting for change in net stock income, with replacements contributing as costs and cull cows as income. This was considered acceptable since only empty cows were replaced during the model simulations with replacement heifers. A fitting of a linear relation was assumed appropriate after omitting some of the extraordinary circumstances that produced extreme 6-week in-calf rates. Lastly, each simulation was replicated with payouts of $4.50, $5.50 and $6.50 per kgMS (Fig. 2).

The relationships demonstrate how EFS is sensitive to payout. The points of interest however are the slopes of each curve because these describe the incremental benefit of improving the 6-week in-calf rate for a given level of payout. Firstly, the slopes are all positive meaning that there is a positive economic benefit with increasing the 6-week in-calf rate, regardless of payout. Secondly, the slope increases as payout increases, indicating that there is more to lose or gain from variances in the 6-week in-calf when

payout is high. The InCalf Economic Model assumes a $5.50 payout, which is also the value the banks are using for lending criteria.

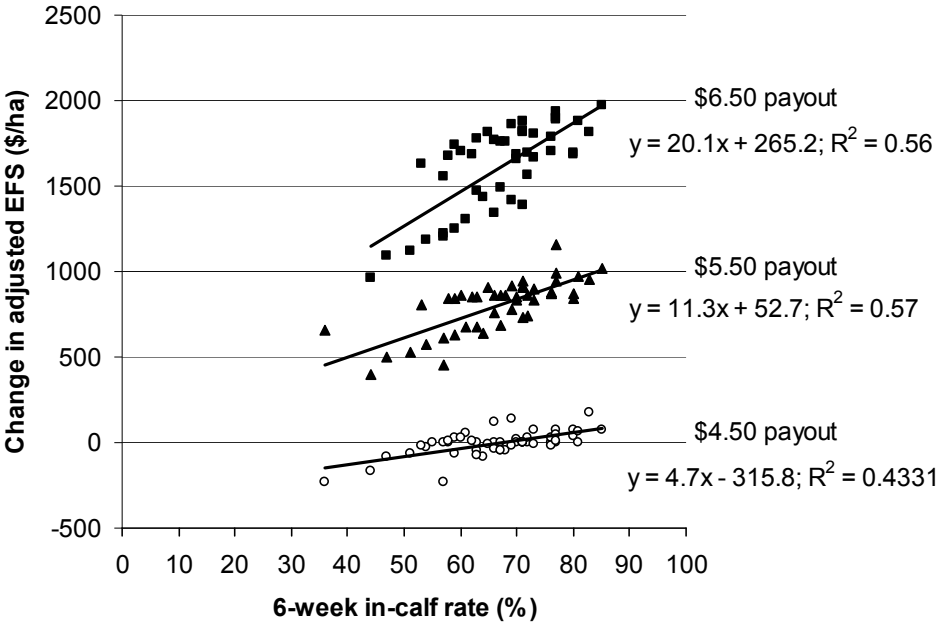

Figure 2. Revised modelled relationships between operating profit (adjusted EFS $/ha) and the 6-week in-calf rate (less costs of empty cows) at payouts of $4.50, $5.50 and $6.50 per kgMS.

The final step in deriving the value of a % change in the 6-week in-calf rate involved converting EFS/ha to a $ benefit per cow in the herd. This was achieved by dividing the slope (in Fig.2) by the average stocking rate of 3 cows per ha used in the WFM simulations. At a $5.50 payout this amounted to (11.3 ÷ 3 cows per ha = 3.77 or) $4 per cow after rounding to the nearest whole number. The total value is then calculated by multiplying this value by the number of cows in the herd, as used in Step 3: 'Assess the benefits' of the InCalf tools.

How is the value of changing the empty rate (%) estimated?

The incremental value of % change in the empty rate was assumed as the differential market value between an in-calf versus empty cow. The value is currently set at $1000 per empty cow, which is equivalent to $10 per % unit for each cow in the herd. This value will fluctuate over time, however, with manufacturing-beef price and the market demand for in-calf (or empty) cows being the main determinants.