Economic impacts of induction reduction strategies

GA Verkerk, CR Burke, M Newman, PC Beukes
DairyNZ Ltd, Private Bag 3221, Hamilton 3240

Introduction

Background to regulatory changes

The use of long-acting corticosteroids to induce calving and shorten gestation length was a technology developed in the 1970's that achieved rapid and widespread adoption because it allowed late-conceiving cows to be retained within seasonal pasture systems (Welch et al. 1973). At that time there were no effective treatments for post-partum anoestrus, and the use of prostaglandins in controlled breeding programmes was in its infancy. While the primary benefit of calving induction was promoted as a reduction of involuntary culling rates, farmers rapidly realised that the resulting compaction of herd calving patterns, synchronised with spring pasture growth, was an effective means to increase milk production and the technique quickly gained wide acceptance with farmers. A survey of 193 Taranaki dairy farmers found that 76% of respondents induced some cows, with a total of 8.1% of all cows in surveyed herds being induced (Bunny 1993). Of farmers that did not induce, 63% cited welfare concerns for the cow as their primary reason for not doing so. Overall opinion, however, was that while the procedure did not cause unnecessary suffering for the cow, it could have a detrimental effect on calf welfare.

As progesterone-supplementation technologies for proactive treatment of post-partum anoestrus were developed, a more proactive approach to reproduction management became feasible along with the possibility that this could reduce reliance on calving inductions (Macmillan and Peterson 1993, Macmillan 1995) which continued to be seen to compromise cow welfare (Tervit 1976, Browning et al. 1990, Hargreaves et al. 1993, Morton and Butler 1995a).

The direct effects of calving induction on subsequent milk yield and reproductive performance were quantified by Hayes et al. (1998). They studied 40 herds calving in spring 1993, in which 11.9% were induced. Annual milk production of induced cows was 7% less than for naturally calving cows, with the reduction greatest in early lactation. While submission rates were similar, conception rate to first service and final in-calf rate were both significantly lower for induced cows (first service conception rate: 54.4% vs 59.5%; final in-calf rate: 91.4% vs 93.6%, for induced and naturally calving cows, respectively). Similar effects had previously been reported in Australian herds that practiced induction (Morton and Butler 1995b&c). McDougall (2001) investigated the effects of periparturient disorders on reproductive performance and reported that induction increased the risk of retained foetal membranes and reduced subsequent pregnancy rates of New Zealand dairy cows.

In accordance with mounting concerns about continued use of high levels of calving inductions, specific industry policy was introduced by the Fonterra dairy company in the document “Market-Focused – an environmental management system for New Zealand dairy farmers” which stated “The industry would like to see the number of inductions to be less than 5% by 2005, and less than 2% by 2010 of total dairy cow numbers” (Anon 2001). Billones et al. (2000) surveyed 218 dairy farmers for their perceptions of industry image and found that 71% of respondents identified induction as having a negative effect on image. It was the most frequently identified practice that the surveyed farmers believed required change to meet consumer expectations.
As reduction targets were communicated to farmers, further studies were initiated to investigate management change to reduce induction levels. A study of the decision-making processes used by farmers (Botha and Verkerk 2002) identified that successful implementation of an induction reduction policy is a continuous process requiring a long term perspective and changes to the farm system to manage risk factors. Achieving appropriate cow condition was acknowledged to be the critical success factor, but aspects beyond the control of the farmer could influence the outcome.

Compton and McDougall (2010) analysed the management and reproductive performance of 82 Waikato herds, with differing induction policies across three consecutive seasons (2002-2005). Herds were classified as Nil (no induction use; n=14), Transitional (used inductions in 2002/03 season but then ceased in either 2003/04 or 2004/05 season; n=12), and Continuing (continued to induce; n=56). There was a significant effect of policy on 8-week in-calf rate. Nil herds had a higher (p=0.01) 8-week in-calf rate than Transitional and Continuing herds (83%, 78% and 79%, for Nil, Transitional and Continuing, respectively). Final empty rates (10.2%, 9.9% and 9.0%, for Nil, Transitional and Continuing, respectively) were similar (p=0.06). Multivariable modeling found that 8-week in-calf rates were associated with many factors including year and predominant breed, but not with the induction policy. A change to ceasing induction tended to be associated (p=0.07) with a 2.5% increase in the final empty rate in the lactation of change.

As an adjunct to the Waikato study, Blackett et al. (2006) examined the decision-making and management implications of changing induction policies. They found that personal values were an important component of farmers’ choice of policy, often irrespective of the financial implications. Those that had ceased inducing did not regret their decision while the key concern of farmers that continued to induce was management of empty rates.

In 2003, a series of abnormal drug reactions were reported to the Agricultural Compounds and Veterinary Medicines (ACVM) Group of the New Zealand Food Safety Authority prompting an investigation. The ACVM Group reassessed the use of corticosteroids to induce parturition and removed it as a label indication. To manage ongoing off-label use, a Code of Practice gazetted under the ACVM Act was introduced in 2005. The code defined selection criteria for cows (age, health, body condition, stage of gestation) and required planning to ensure adequate feeding and management of metabolic disease and negative post-calving sequelae. While the effectiveness of this change has not been assessed, it is widely held that undesired outcomes were reduced following the code’s introduction.

The ACVM Code of Practice expired in 2010, coinciding with regulatory reform of the ACVM Act. Broad-based codes of practice for off-label product use were replaced by a requirement for an Operational Plan specific to individual circumstances. In 2010, the previous industry target, as had been presented in Fonterra’s Market-Focused programme, also expired. Dairy company and veterinary practice survey information suggested that across the country fewer than half of all dairy farms were carrying out inductions, and that fewer than 5% of cows in the national herd were being induced. However, some farmers continued to induce large proportions of their herds. Anti-induction sentiment has continued to build as consumers and the New Zealand community increasingly questions the welfare provenance of food derived from modern animal production systems. For example, the National Animal Welfare Advisory Committee established their position in the Animal Welfare (Dairy Cattle) Code of Welfare (Anon 2010) with the explicit statement that it “does not support the use of induction of otherwise healthy cows in order to manipulate calving patterns”.

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Coincident with the changing regulations, an industry stakeholder group, comprised of New Zealand Veterinary Association, Dairy Companies Association of New Zealand, DairyNZ and Federated Farmers of New Zealand, was established to consider how the code might be replaced in a way that preserved consistency of practice, and how further reduction of inductions could be promoted. This led to development of an operational plan template based on the previous code of practice and a memorandum of understanding that established targets for maximum induction levels on individual farms from 2010 to 2012 as a means to reduce the use of the technology further. Given that public and regulatory pressure against inductions is unlikely to abate, it is highly probable that future regulations will impose further limitations. It is important that the interim period is used to assist farmers that have become reliant on inductions as their key reproduction management tool to explore alternative management strategies.

**Economics of inductions**

Many farmers that continue to use inductions believe that the procedure is important for their overall farm profitability and are concerned that increasing restrictions will result in lower farm income. Developing an understanding of the economic impact of the policies of nil or fewer inductions is, therefore, important for supporting change in farming practice.

Stevens et al. (2000) reported a study of the economic impact of induction using data obtained from 1003 farms from 1996/97 to 1998/1999. To be eligible for inclusion, participating farmers were required to have had constant ownership, herd size and location, and a high level of recording during the survey years so that production information from the national database could be included. The consequence of this was that the survey population did not include expanding farms and the resulting population was biased towards owner/operators rather than sharemilkers. The average use of induction on these farms was 7%, with 18% using no inductions. Comparison of records between inducing and non-inducing farms confirmed previous observations that while induced cows produced less and had a lower chance of survival to the next lactation than non-induced cows, herds where inductions were performed had higher milk production and a higher rate of cow survival to subsequent seasons as benefits of an earlier mean calving date.

Based on the survey data, the impact of removing induction was predicted by economic modeling (Stevens et al. 2000). They found that the effect of stocking rate on feed utilisation influenced economic outcomes such that inductions were more profitable where stocking rate was increased. Based on a 200-cow farm inducing 7.5% and costs relevant to that time ($3.50/kg MS; four day old calf $60; cost of induction $37.60/cow; marginal replacement cost $400/cow) the Net Present Value of induction over five years was $44-$96/induced cow or $662-$1445/farm ($10 to $22/ha), with variation dependent on stocking rate policy.

A subset of 76 non-inducing farmers from the survey was interviewed about their specific management strategies and 48 provided data to calculate Economic Farm Surplus (EFS; gross farm profit, less operating expenses) for comparison against industry benchmarks (Stevens et al. 2000). Non-inducing farms exceeded national average performance by 40% for both EFS/ha and EFS/cow. On the basis of their findings, Stevens et al. (2000) concluded that non-induction policy can be implemented without economic penalty.

Beukes et al. (2005) used a whole-farm simulation model (WFM) to explore the economic consequence of two non-induction strategies for Lincoln University Dairy Farm (LUDF) which ceased inductions in 2003. Developments with the WFM have enabled calving patterns to be predicted across seasons allowing reproductive performance associated with varying mating
management policies to be simulated (Beukes et al. 2010). Scenarios modeled were Induction incorporating the previous induction rate of 11%, No-management with no inductions and mating limited to 10 weeks without other management change, and Cull-and-replace in which mating was limited to 10 weeks, heifer replacement rate was 25%, heifer replacements were synchronised to calve one week before the main herd, and stocking rate was increased to ensure available feed was fully utilised. Simulations were based on a milk price of $3.90/kg MS, $40/cow cost of induction, and a marginal replacement cost $150/cow.

When simulations were run for five years, EFS/ha differed between scenarios (average EFS/ha: $2203, $2116 and $2098 for Induction, No-management and Cull-and-replace, respectively; P<0.001). Simulations were also run for eight consecutive years to examine for carry-over effects. Mean calving date advanced progressively for both Induction and Cull-and-replace scenarios, but remained constant with the No-management scenario. Milk solids production/cow was consistently highest with the Induction scenario, although in three of the eight years the Cull-and-replace scenario gave similar results. Returns from the Cull-and-replace scenario improved with time and after five years were similar to that of the Induction scenario. This was attributed to an overall advance in mean calving date with resultant increases in days-in-milk. The authors concluded that with consistent implementation for a sufficient period, the Cull-and-replace strategy had the potential to match the farm profitability of the Induction strategy (Beukes et al. 2005).

This paper now presents the results of two further investigations of the potential economic impact of reducing induction strategies:

- Multiple year simulation using the WFM to explore the economic impact of the induction reduction targets introduced in 2010; and,
- An analysis of data from farms registered with DairyNZ’s DairyBase (database of farm physical and financial performance) to determine any associations between induction rates and operating profits, production and animal health costs.

**Whole farm model simulations**

Modelling was undertaken using the WFM version 4.7. The WFM is a VisualAge Smalltalk (IBM) framework linking sub-models of pasture growth (McCall and Bishop-Hurley 2003) and cow metabolism (Baldwin 1995). Modified for the New Zealand situation (Palliser et al. 2001) the model was designed to simulate the complex interactions of climate, pasture, animals and management on a dairy farm and link multiple physical performance factors in a holistic way to profitability. The WFM generates multiple-year outputs of the physical and financial performance of the simulated scenario.

The key measure being used by the dairy industry to compare profitability between farms is now operating profit per effective hectare (OP/ha). This is the difference between gross farm revenue (cash income from milk, culls, and calf sales, with a non-cash adjustment for change in livestock numbers) and operating expenses (cash farm working expenses with non-cash adjustments for unpaid labour and management, owned run-off, change in feed inventory and depreciation). This parameter is very similar to EFS/ha, as has been used in previous studies, except for slight differences in the way that adjustments are made for some non-cash items such as unpaid labour. The WFM simulations generate estimates for the key income and cost factors using relevant values established through the DairyNZ economic farm survey and DairyBase. Aspects of farm management such as costs of labour inputs are kept constant for all scenarios in the simulations. In the simulations described, costs and income were based on data from 2008: $5.70/kg MS, the
value of cull cows was $700, calves were worth $110 and the cost of induction was $40/induced cow.

The WFM simulates reproduction events using an approach that reflects the physiological events required for postpartum cows to re-establish pregnancy. Inputs for oestrus detection efficiency, and simulation of subsequent conception and pregnancy rates RE (what is RE?) derived on an individual animal basis to predict indicators of herd-level reproduction performance including submission rate (SR), induction rate and six week and final in-calf rates (Beukes et al. 2005, Beukes et al. 2010). When the model is run for a series of successive years, the cumulative impacts of reproduction management can be estimated.

Recent survey data indicates that inductions are used more often in larger herds in areas of industry expansion, so it was considered important that the simulated scenarios should reflect this group of farms. Accordingly the model was initialised with cow and pasture/crop data from the Southland Demonstration Farm (SDF). This farm in Southland has 750 cows and an average annual induction rate of 8%. It is managed according to regional practices, including wintering on brassica and fodder beet crops, with heifer replacements sent to graziers after weaning.

An animal input file of 100 cows was compiled for the simulation based on the observed initial live-weight, age and calving patterns at the start (1 June) of the 2009/10 season. A land input file was compiled using the observed covers for 15 paddocks at the start of the 2009/10 season. Paddock sizes were proportionally reduced from the observed to generate the model input such that final stocking rate was 2.54 cows/ha (100 cows on 35.6 ha pasture and 3.7 ha brassica crop).

Planned start of calving for the simulations was 10th August each year reflecting practices on the SDF. Planned start of mating was 30th October each year for cows and 23rd October for heifers. Cows were bred to artificial insemination for six weeks and then bulls were used for the balance of time in each scenario. To simulate the induction procedures, cows due to calve in weeks 11/12 and weeks 13/14 after planned start of calving were managed in two groups with calving dates advanced by eight weeks into weeks 3/4 and 5/6 respectively. The lactation production of induced cows was reduced by 6% and fertility of induced cows in the subsequent mating period was also reduced in accordance with the observations of Hayes et al. (1998).

Implementation of an induction-reduction policy will increase empty rates because the length of the mating period must be restricted if protracted herd calving patterns are to be avoided. A likely increase in demand for replacements needs specific consideration. The policy adopted for the simulations was that all replacements were introduced as two year old heifers. All artificially-bred (AB) heifer calves were retained and reared as replacements, with any surplus to requirements sold as in-calf heifers. The default herd replacement rate was 20% per annum, and empty cows were prioritised for culling. Where simulations resulted in an empty rate less than 20%, further culls were selected on the basis of production to bring the culling rate up to 20%. Where empty rate was greater than 20%, culling was permitted to increase and numbers were maintained by introducing more heifers.

Culling was simulated in several batches to reflect farm practices – 2% of milkers were removed in mid-September each year and 2% in January. In mid-April (i.e. post-pregnancy testing cull) cows identified as empty were removed, up to a total of 30%. Where empty rates were higher, empty cows were retained until mid-May when there was a further 2% cull after sorting cows by empty/oldest/lowest milk production. This strategy was needed to maximise the use of available feed supplies. In an early simulation iteration where all empties were culled in mid-March after pregnancy testing, those scenarios with higher empty rates ended the year with significant feed
reserves. While the value of that feed carried forward is included in the calculation of adjusted operating profit, it was considered that this would be an unrealistic strategy on-farm where accumulated feed reserves would more likely be fed to extend lactation of empty cows. A final adjustment at the end of May each year was made to return the total number of cows to 100 for the following season.

Once initialised, six scenarios were explored by simulating six different reproductive management/induction policies as follows:

a) Best Practice: included as an aspirational target, this scenario simulated achievement of InCalf targets (21d SR; six week and final in-calf rates) with 0% inductions and a 10 week mating period (anon 2010b)

b) 15%: 15% inductions, 14 week mating period
c) 8%: 8% inductions, 14 week mating period
d) 4%: 4% inductions, 14 week mating period
e) 0%_12 week: 0% inductions, 12 week mating period
f) 0%_10 week: 0% inductions, 10 week mating period

The simulations were carried out across five years to examine the impact of the management strategies on farm income and expenditure streams. Annual weather data input was constant i.e. the same annual weather data was used for each year of the five years simulated, with two simulation runs using weather data for 2006/07 and 2009/10 years. This approach was chosen for this study because previous simulations by the WFM of reproductive outcomes of specific management strategies have found that variability associated with climate, especially during more extreme years, far exceeds variability associated with management intervention (Beukes et al. 2010). Mean output values were calculated based on years 2-5 as Year 1 of the simulation was part of the initialisation process so did not reflect the impact of the management strategies. Variability within each series of four years is described in the data as a standard error of the mean (sem) specific for parameter and scenario. Variability between scenarios were analysed in Genstat v13, using a randomised block design blocked by weather-data year. Model outputs of key financial parameters for each scenario are summarised in Table 1a&b and Figure 1a&b shows adjusted operating profits for the two sets of simulations.

Figure 1. Average adjusted operating profit ($/ha) for the six simulated scenarios using weather data (a) from 2006/07, and (b) from 2009/10
Incomes from milk sales varied between scenarios \((p=0.022)\). The Best Practice, 15% and 8% induction scenarios were similar and around 1.5% higher than the 4% and two nil induction scenarios which were also similar (Table 1a&b). This observation matches commonly held farmer opinion that inductions promote higher overall production. It confirms the importance of compact calving patterns for maximising milk production, while the similarity between Best Practice and the two higher levels of induction reflects the way in which the procedure corrects herd calving patterns to capitalise on the spring pasture growth curve. The number of days in milk (DIM) varied between scenarios \((p>0.001)\). The 0%_10 week scenario had the greatest number of DIM because empty cows were retained longer to use predicted feed surpluses (Table 1a&b). Differences in milk production are, therefore, a likely consequence of the higher proportion of heifers (which have lower milk production) entering the 4% and nil induction scenarios to compensate for higher empty rates (Table 1a&b).

### Table 1a&b.

Average (sem) of model outputs ($/ha) over four years (a: for weather data based on 2006/07 season; b: for weather data based on year 2009/10 season for annual income (milk sales and culls) and costs (stock grazing, feed costs, farm working expenses), and adjusted operating profit ($/ha) for the six simulated scenarios (Best Practice: InCalf targets achieved, 15%: 15% ongoing annual herd induction rate; 8%: 8% induction rate; 4% 4% induction rate; 0%_12 week: nil inductions and 12 week mating period; 0%_10 week: nil inductions and 10 week mating period). The sem value describes variability between simulation years within each scenario.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Best Practice</th>
<th>15%</th>
<th>8%</th>
<th>4%</th>
<th>0%_12 week</th>
<th>0%_10 week</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 2006/07 weather data</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk sales ($/ha)</td>
<td>5431 (17)</td>
<td>5390 (10)</td>
<td>5378 (7)</td>
<td>5352 (30)</td>
<td>5293 (39)</td>
<td>5331 (22)</td>
</tr>
<tr>
<td>Days in milk (d)</td>
<td>253 (1.1)</td>
<td>250 (0.5)</td>
<td>254 (0.9)</td>
<td>253 (1.1)</td>
<td>248 (0.9)</td>
<td>257 (0.6)</td>
</tr>
<tr>
<td>Final empty rate (%)</td>
<td>11 (0.5)</td>
<td>11 (0.5)</td>
<td>16 (0.6)</td>
<td>21 (1.0)</td>
<td>21 (0.7)</td>
<td>28 (0.3)</td>
</tr>
<tr>
<td>Adjusted operating profit ($/ha)</td>
<td>2059 (15)</td>
<td>1954 (27)</td>
<td>1951 (14)</td>
<td>1965 (35)</td>
<td>1956 (44)</td>
<td>1961 (26)</td>
</tr>
<tr>
<td>Stock sales ($/ha)</td>
<td>681 (29)</td>
<td>606 (54)</td>
<td>641 (45)</td>
<td>628 (48)</td>
<td>601 (44)</td>
<td>646 (43)</td>
</tr>
<tr>
<td>Stock grazing costs ($/ha)</td>
<td>684 (22)</td>
<td>608 (40)</td>
<td>644 (35)</td>
<td>634 (37)</td>
<td>607 (35)</td>
<td>651 (34)</td>
</tr>
<tr>
<td>Feed costs ($/ha)</td>
<td>1006 (51)</td>
<td>991 (45)</td>
<td>983 (48)</td>
<td>982 (44)</td>
<td>1008 (57)</td>
<td>971 (44)</td>
</tr>
<tr>
<td>Farm working expenses ($/ha)</td>
<td>4151 (65)</td>
<td>4069 (71)</td>
<td>4099 (77)</td>
<td>4089 (80)</td>
<td>4079 (84)</td>
<td>4096 (65)</td>
</tr>
<tr>
<td>b) 2009/10 weather data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk sales ($/ha)</td>
<td>5404 (25)</td>
<td>5410 (27)</td>
<td>5396 (17)</td>
<td>5321 (34)</td>
<td>5338 (33)</td>
<td>5301 (31)</td>
</tr>
<tr>
<td>Days in milk (d)</td>
<td>253 (0.5)</td>
<td>250 (0.6)</td>
<td>253 (0.6)</td>
<td>253 (1.1)</td>
<td>249 (0.5)</td>
<td>257 (0.6)</td>
</tr>
<tr>
<td>Final empty rate (%)</td>
<td>11 (0.5)</td>
<td>11 (0.7)</td>
<td>14 (1.2)</td>
<td>18 (0.4)</td>
<td>19 (0.5)</td>
<td>27 (1.7)</td>
</tr>
<tr>
<td>Adjusted operating profit ($/ha)</td>
<td>1673 (21)</td>
<td>1620 (34)</td>
<td>1615 (11)</td>
<td>1584 (23)</td>
<td>1604 (30)</td>
<td>1590 (34)</td>
</tr>
<tr>
<td>Stock sales ($/ha)</td>
<td>686 (28)</td>
<td>592 (64)</td>
<td>628 (47)</td>
<td>673 (38)</td>
<td>623 (44)</td>
<td>5672 (41)</td>
</tr>
<tr>
<td>Stock grazing costs ($/ha)</td>
<td>691 (21)</td>
<td>595 (50)</td>
<td>627 (32)</td>
<td>677 (25)</td>
<td>631 (35)</td>
<td>678 (33)</td>
</tr>
<tr>
<td>Feed costs ($/ha)</td>
<td>781 (55)</td>
<td>782 (54)</td>
<td>779 (51)</td>
<td>761 (46)</td>
<td>791 (55)</td>
<td>768 (49)</td>
</tr>
<tr>
<td>Farm working expenses ($/ha)</td>
<td>3935 (72)</td>
<td>3847 (95)</td>
<td>3878 (70)</td>
<td>3909 (50)</td>
<td>3889 (79)</td>
<td>3920 (71)</td>
</tr>
</tbody>
</table>

Despite more income from milk sales in the Best Practice and higher induction scenarios, overall adjusted OP/ha were similar, except for the Best Practice scenario which generated the highest adjusted OP/ha \((p=0.013;\) Table 1a&b). This was a consequence of the interplay between income from stock sales (culls and reared heifers excess to requirements), costs of grazing (i.e. rearing young stock), feed costs (costs of silage conservation and planting/maintenance of winter crops) as well as differences in farm working expenditure.
The adjusted OP/ha was greatest for the Best Practice scenario (margin of +$59/ha or +3.7% compared to overall-average adjusted OP/ha) which supports the contention that achievement of InCalf targets will improve overall farm income. Aside from this aspirational scenario, the overall effect of altered induction policy on adjusted OP/ha was small, with a margin of only $36/ha between scenarios. Compared to the average adjusted OP/ha of $1603 for the other five scenarios, the differences were +$17 (+1%), +$12 (0.7%), -$19 (-1.1%), +$1 (+0.01%) and -$13 (-0.8%), for the 15%, 8%, 4%, 0%_12 week and 0%_10 week scenarios, respectively.

**DairyBase analysis**

In this study the objective was to look for associations between induction rates and operating profits, production and animal health costs on farms that had provided both physical and financial data to DairyNZ’s DairyBase database in at least one of the four years from 2006/07 to 2009/10. The DairyBase dataset consisted of 123 herds from 2006/07, 216 herds from 2007/08, 229 herds from 2008/09 and 136 herds from 2009/10. These herds were both owner-operator and 50:50 sharemilkers, so data from these two groups were analysed separately. While milk production/ha may reflect how well feed is turned into milk, it is a poor indicator of operating profit/ha. Costs of production vary considerably between herds and explain over 60% of the variation between farms in operating profit.

Induction use varied between years with an increase in 2009/10. This may reflect both the consequences of wide-spread drought in 2008 as well as farmers’ response in anticipation that regulatory changes in 2010 would limit their future opportunity to induce. The average herd-level induction rate in 2006/07 and 2007/08 seasons was 3%, increasing to 4% in 2008/09 and 5% in 2009/10. Across the study years, between 38 and 52% of farms did not induce any cows, 9-13% induced up to 4% of the herd, 19-27% induced 4-8%, 12-17% induced 8-12%, and 2-14% induced more than 12%. In herds where inductions were used, the herd size was on average 150 cows more than in herds where inductions were not used.

The DairyBase datasets for sharemilker and owner-operator owned herds were analysed within year for associations between the rate of induction use and factors of herd size, production system (DairyNZ classification: System 1- all grass, self contained, all stock on the dairy platform, to System 5 – approx 25-40% (up to 55%) feed imported, imported feed used throughout lactation and for dry cows; (Anon, 2011), region, OP/ha, animal health costs/cow, operating expenses/kg MS and milk production (kg MS/ha). Correlative associations were poor, inconsistent between seasons, and not statistically significant (Tables 2a&b).

**Table 2a.** Correlation coefficients (R²%) between key farm performance indicators (herd size, production system (scale 1-5), region, operating profit/ha, animal health expenses/cow, operating expenses/kg MS, production (kg MS/ha) and induction rates for sharemilker-owned herds

<table>
<thead>
<tr>
<th>Herd size</th>
<th>Production system</th>
<th>Region</th>
<th>OP ($/ha)</th>
<th>Animal health expenses ($ cow)</th>
<th>Operating expenses ($/kg MS)</th>
<th>Milk production (kg MS/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006/07</td>
<td>8%</td>
<td>2%</td>
<td>8%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td>2007/08</td>
<td>2%</td>
<td>5%</td>
<td>2%</td>
<td>3%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>2008/09</td>
<td>2%</td>
<td>2%</td>
<td>10%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>2009/10</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>13%</td>
<td>13%</td>
</tr>
</tbody>
</table>

7.12.8  
*Proceedings of the Society of Dairy Cattle Veterinarians of the NZVA, 2011*
Table 2b. Correlation coefficients ($R^2\%$) between key farm performance indicators (herd size, production system (scale 1-5), region, operating profit/ha, animal health expenses/cow, operating expenses/kg MS, production (kg MS/ha) and induction rates for owner-operator herds

<table>
<thead>
<tr>
<th>Year</th>
<th>Herd size</th>
<th>Production system</th>
<th>Region</th>
<th>OP ($/ha)</th>
<th>Animal health expenses ($ cow)</th>
<th>Operating expenses ($/kg MS)</th>
<th>Milk production (kg MS/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006/07</td>
<td>2%</td>
<td>2%</td>
<td>18%</td>
<td>6%</td>
<td>4%</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>2007/08</td>
<td>9%</td>
<td>8%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>2008/09</td>
<td>9%</td>
<td>8%</td>
<td>3%</td>
<td>2%</td>
<td>6%</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>2009/10</td>
<td>20%</td>
<td>2%</td>
<td>2%</td>
<td>7%</td>
<td>12%</td>
<td>2%</td>
<td>11%</td>
</tr>
</tbody>
</table>

Figures 2a & b also demonstrate the lack of relationships between OP/ha and induction rates for sharemilker and owner-operator owned herds in 2009/10.

Figures 2a & b. Correlations between operating profit ($/ha) and induction rate (% of herd induced) for a) sharemilker ($R^2 = 0.01; P = 0.44$) and b) owner-operator ($R^2 = 0.07; P = 0.32$) owned herds in DairyBase for the 2009/10 season

Discussion

Both recent studies described here demonstrate that, while higher levels of induction may be associated with slightly higher farm profitability, the overall impact on farm operating profit from routine use of inductions as a management tool to correct herd calving patterns is small. Higher induction use is strongly associated with higher milk production/ha, which reflects how well feed is turned into milk, but is a poor predictor of operating profit/ha as costs associated with milk production vary considerably between herds.

These results are consistent with the previous studies of the economic impact of changes to induction policy. Although Stevens et al. (2000) based their data on values derived from farms with stable ownership and size, and expressed their model outputs as nett present value over five simulated years, their estimate was that inductions generated between $10 and $22 /ha, depending on the stocking rate policy implemented. Previous WFM simulations reported by Beukes et al. (2005) also predict marginal increases in EFS from inductions. Their simulation of an 11% induction rate indicated an EFS margin of 4-5% compared to the other strategies simulated, although after five years of consistent implementation of the heifer management strategy, EFS converged with that of the continuing induction scenario.
The WFM simulation study reported here also suggests that OP/ha is positively influenced by induction rate, but the gain was less than 1% of average OP/ha for the scenarios simulated even though only limited management strategies, focused on heifer replacement and culling, were used. Real-world situations would more likely introduce several management strategies when implementing an induction-reduction policy which could further constrain the economic impact of change. Possibly of more importance is that the simulations strongly support an opportunity for greater profitability if herd reproductive performance can be improved to achieve InCalf targets.

While the analysis of DairyBase data also showed a positive association between induction rates and operating profit, this was small and not statistically significant. Figures 2 a&b demonstrate the existence of wide ranging farm financial performance irrespective of induction policy and ownership status. In fact, many farms appear to perform poorly, despite high induction rates, while farms with nil induction policies are profitable.

The various studies reported have been carried out at different times in the past 15 years, so a range of milk and other farm income/costs have been used e.g. Stevens et al. (2000) based their model on a milk price of $3.20/kgMS while the WFM simulations reported here used $5.70/kgMS – both values being lower than current prices being paid to producers. These differences will introduce variation in overall results, but does raise the issue as to whether in fact inductions are more profitable in years with high milk price – a factor which may itself have also contributed to the increased induction rates reported in the DairyBase data in 2007/08 and 2008/09. The milk price of $5.70 was chosen for the WFM simulations to represent an “average year” however if higher milk prices continue without other costs increasing proportionately, then the impact of changed policy on farm incomes may be greater than that identified in the simulations reported here.

Conclusions

Given the likelihood that there will be further controls on the use of calving inductions in the future, whether by regulatory imposition or as change is driven by industry commitment to meet consumer and community expectations about ethical food production methods, loss of this as a routine management tool to correct herd calving patterns should not result in undue economic hardship. Their overall contribution to profit is small, and many other factors that influence farm profitability come into play.

A range of management strategies relating to heifer management has been explored. These have been shown to be effective in mitigating the economic impact of changes to induction policies on farm, while management to achieve the best practice targets described by the “InCalf” programme may not only mitigate, but enhance farm operating profit.

References


Economic impacts of induction reduction strategies


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Morton JM, Butler KL. The effects of induced parturition on the incidence of clinical disease and mortality in dairy cows from commercial herds in south-western Victoria. *Australian Veterinary Journal* 72, 1-4, 1995a

Economic impacts of induction reduction strategies


