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# *Staff Paper*

Analyzing Reproductive Management  
Strategies on Dairy Farms

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Staff Paper 99-23

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## Analyzing Reproductive Management Strategies on Dairy Farms

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Milk sales are the largest source of revenue on dairy farms. Reproduction is necessary to generate a new lactation. However, a pregnancy also dictates when the previous lactation must end so that the cow can retain sufficient condition into her new lactation. Pregnancy rate and estrus detection rate determine reproductive success. From an economics point of view, we talk about calving interval or days open so that a dollar value can be easily associated with the reproductive management program.

15 pages

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# **Analyzing Reproductive Management Strategies on Dairy Farms**

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## **Analyzing Reproductive Management Strategies on Dairy Farms**

Milk sales are the largest source of revenue on dairy farms. Reproduction is necessary to generate a new lactation. However, a pregnancy also dictates when the previous lactation must end so that the cow can retain sufficient condition into her new lactation. Pregnancy rate and estrus detection rate determine reproductive success. From an economics point of view, we talk about calving interval or days open so that a dollar value can be easily associated with the reproductive management program.

In the popular dairy press there exists a wide range of values from that find the cost of days open to be negative, for extremely short calving intervals, to several dollars a day for extended calving intervals. There are a number of assumptions behind these reproductive performance values and some or all may not fit the situation on any given farm. While these numbers are useful to bench-mark and perhaps ballpark the impact of different calving intervals. One consistent result in the reproductive management research, however, is that the optimal calving interval is around 13 months with income lower both above and below that calving interval. This paper deals with the areas that reproductive efficiency affects net farm income on dairy farms. We examine costs and benefits from changes in reproductive management. The take-home message is that farm managers should use their individual farm numbers to assess potential changes in the reproductive management plan.

### **Effects of Calving Interval Length**

Extended calving intervals result in more milk, and consequently milk revenues, per lactation but not necessarily more profit per year (or day). The potential costs from low reproductive success, an extended calving interval, include:

- lower average milk yield,

- more non-productive days,
- more culling for reproductive reasons,
- higher costs to treat infertility,
- less AI offspring which can mean a loss in genetic advance as well as additional costs if raising heifers is cheaper than purchasing heifers.

To illustrate the milk production effects of an extended calving interval, consider figures 1 and 2. Figure 1 is a single lactation curve. A shorter calving interval results in less total milk—the area under the curve—and a higher average milk production per day as the peak milk has a larger effect. The shaded area in figure 1 is the foregone milk when the calving interval is shortened by a new pregnancy.

Figure 2 illustrates two lactation curves with two alternative reproductive strategies over these lactations. Strategy A is the dashed curves representing a 13 month calving interval while strategy B is a 16 month calving interval represented by solid lines. Table 1 displays the total and daily milk production over two lactations for a 20,000 pounds/year milk producing cow under the two reproductive strategies. The result is that while strategy A results in over 3,000 pounds less in total milk production over two lactations, it also means 10 pounds more milk per day. Aggregated over an entire herd, and considering the opportunity cost of that cows place in the milk production facilities, this is potentially a significant increase in milk production and revenues.

The economic effects of shorter calving interval, assuming a constant herd size for clarity, include:

- more milk per day,
- more dry cows (as spend higher percent of time dry),

- more calves,
- more culling,
- more feed costs as feed for higher milk production,
- potential investment in facilities and labor for increased dry cows and calves.

### **The Partial Budget Approach**

Partial budgets are one way to evaluate proposed changes in reproductive management. Partial budgeting looks only at a proposed change to a single enterprise—distinct from capital budgeting or whole farm budgeting. Reproductive change can affect the bottom line through increased revenues and decreased expenses, which are profit additions due to management changes, as well as through decreased revenues and increased expenses, which are profit subtractions due to management changes. The result of these effects is the net change to enterprise profit from the management change.

The steps involved in calculating a partial budget are:

1. *Identify goals and options to be investigated.* Below we examine achieving a 13 month calving interval using the Ovsynch protocol.
2. *Identify revenues and expenses to consider.*
3. *Estimate revenue and expense changes.* Individual farm records and budgets may be used to arrive at reasonable values.
4. *Associate changes with a positive or negative impact on the business.*
5. *Perform sensitivity analysis for key factors.* This simply involves examining at the potential effects from changes in key variables.
6. *Review outcome in a “whole” farm perspective.* Determine whether this management style fits the manager and facilities.

With a shortened calving interval we expect increased revenues from milk, calves, culls, and artificial insemination and increased expenses from feed, labor, replacements, and supplies and services. There might also be other management changes that include decreased revenues or expenses but none were obvious for this example.

The data required for the partial budget includes herd size, milk production level, milk price, calf price, cow price, replacement price, reproductive variables, feed expenses, labor expenses, and supplies and services expenses. These numbers should be readily available from farm record keeping systems. By using individual farm values, a farmer can effectively evaluate proposed reproductive management changes.

### **Ovsynch Example**

Ovsynch is a protocol for synchronizing ovulation in cows. The protocol involves three injections—two of gonadotropin releasing hormone and one of prostaglandin F 2- $\alpha$ . Costs used in this example are:

$$\begin{array}{r} 2 \text{ injections GnRH @ } \$5.52/\text{dose} = \$11.04 \\ +1 \text{ injection PGF}_{2\alpha} \text{ @ } \$3.30/\text{dose} = \$3.30 \\ \hline \text{Total cost of injections} = \$14.34/\text{service} \end{array}$$

Using average of 2.13 services to generate a pregnancy the cost of Ovsynch is:

$$\$14.34/\text{service} \times 2.13 \text{ services/pregnancy} = \$30.54/\text{pregnancy}.$$

We assume no added labor cost for the Ovsynch protocol as estrus detection is eliminated.

Basically, the assumption is an equal trade-off between estrus detection labor and labor for the injections. If this assumption did not hold the labor values would be changed in the budgets below to reflect changing labor requirements.

### **Partial Budget for 16 to 13 month Calving Interval using Ovsynch**



Tables 2 and 3 illustrate a partial budgets for a representative herd with 200 lactating cows where the reproductive change is using Ovsynch to achieve a 13 month calving interval starting from a 16 month calving interval. Below is a discussion of definitions and data sources for completing the partial budget.

This partial budget is on an annual basis. While daily basis is also possible, it is not acceptable to budget over a lactation as the lactation length depends critically on the reproductive variables that are the focus of this budget. The goal is to maximize profits over time, not per lactation. The analysis should concentrate on one or a few select changes in any given partial budget or else the effects will be obscured and confused across the changes.

The “**Assumption**” section is for inputting relevant herd and reproduction variables as well as prices and expenses for your operation.

Use the average number of **lactating cows** in the past year—or the average number expected over the period to be examined. This is often determined by the capacity of the milking facilities.

The number of **dry cows** is a function of the calving interval and the number of lactating cows. The spreadsheet that produced these budgets, available from the author, calculates the minimum required number of dry cows based on the calving interval in the “Herd Information” section.

**Calving interval** (CI) should be the current calving interval in the current situation column. Reproductive success often revolves around changing, usually shortening, the calving interval so the proposed change will likely show up here. The optimal calving interval is around 13 months.

Milk production is represented as milk/cow in pounds per year. This reflects the herd average and daily milk changes as a function of the length of the lactation as a shorter lactation maximizes the amount of peak milk yield. The budget uses this average, or typical if you prefer, milk production along with the calving interval and voluntary waiting period to calculate a daily milk production level.

The **voluntary waiting period** (VWP) is the amount of time after birth until the cow is bred.

**Calf death losses** are expressed as a percentage.

The **feed cost** is for the “average” (or typical) marginal increase in milk production from increasing milk production by shortening calving interval. Keep in mind that the last pound of milk is harder to produce than the first.

**Replacement cost** is the cost of a springing heifer (or other suitable replacement).

**Culling rates** might differ because the single biggest reason for culling in most dairies is reproductive problems. If this will not change with the management change, then make them equal.

**Cull cow value, calf price, and milk price** are also self explanatory. This budget examines the milking herd enterprise only so all calves are sold immediately, to the heifer enterprise if you prefer, and are purchased back as replacements in the expenses section. For this reason, enter an “average” calf price that reflects the heifer sales.

**Interest rate** is the cost of capital.

Extra **labor** might be required for the milk cows (higher milk production). The dry cow labor is the average labor for dry cows as shortening the CI will mean more dry cows. The applicable **wage rate** is also needed.

The veterinary, medicine, supplies, facilities, and AI costs come from accounting records/budgets. If you calculate a cost of production, then you likely have the numbers to put into this section readily available. The values used in these budgets are from Dr. Sherrill Nott's budgets using Telfarm Michigan data.

One final category (and more if you insert rows and make the appropriate changes to the “**Expenses**” section) is available for other changes that might be part of the reproductive management program.

**Herd Information** is used by the spreadsheet to calculate the days open, dry cows, calves (born and sold after death losses), cows culled, and milk production for the revenues and expenses sections.

**Revenues** come from milk production, calf sales and cull cow sales. If the new cull rate is less than the current cull rate, cull cow income may go down. However, in this case, the expenses will reflect less replacement costs.

**Expenses** also follow the assumptions above.

Note that both revenues and expenses are expressed per lactating cow per year. **Net result** is expressed both per lactating cow and for the entire lactating herd on an annual basis.

Table 2 shows that at a milk price of \$14/cwt. and with the other price information we assumed, the net effect of decreasing the calving interval from 16 to 13 months totals \$15,063. Keep in mind that this is a large change in reproductive performance—a change that would not happen immediately. The increase of \$15,063 is after all is said and done without regard to cash flow or timing of revenues and expenses.

There exists cases where some of the prices or costs do not stay at the levels we assumed. Those are taken up in the next section on sensitivity analysis.

## **Sensitivity Analysis**

Sensitivity analysis entails examining stability of results. That is, there are several important values used in the budget that the farmer has little or no control over. For sensitivity analysis, we examine the potential effect of a decrease in milk price.

In the result found in table 2, the net increase was over \$15,000/year for the 200 lactating cow herd. Table 3 displays the results of a budget identical to the assumptions in table 2 in every way except the milk price is \$12/cwt rather than \$14/cwt. The effect on the revenues and net income is drastic with the increase in income totaling only \$1,047. This happens because the increase in milk revenues is the major benefit from shortening the lactation. The increase in average daily milk production provided the increase in income. The result, is indeed sensitive to the milk price. One might conclude that this management change pays even at \$12 milk. However, one might also decide that a practice such as Ovsynch is not worth the trouble for \$1,000.

Sensitivity analysis can also be performed using other important assumptions (e.g., labor costs, cow prices, etc.).

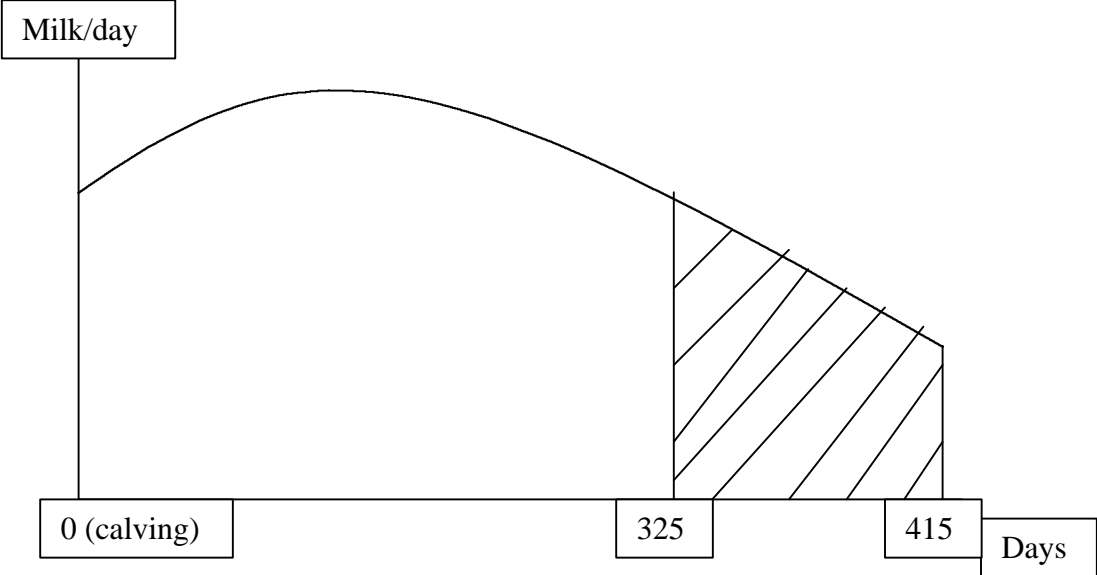
## **Conclusions**

Reproductive management does affect the profitability of dairy enterprises. The returns diminish as a herd approaches the optimum—that is, there is a higher benefit from decreasing the calving interval one-month from 16 months than from 14 months.

A farmer or analyst should use individual farm numbers when analyzing a reproductive management. While representative numbers, such as the ones presented in the tables here, can be useful to get a general idea of potential magnitudes, management decisions should ultimately be based on the specific situation of the operation in question.

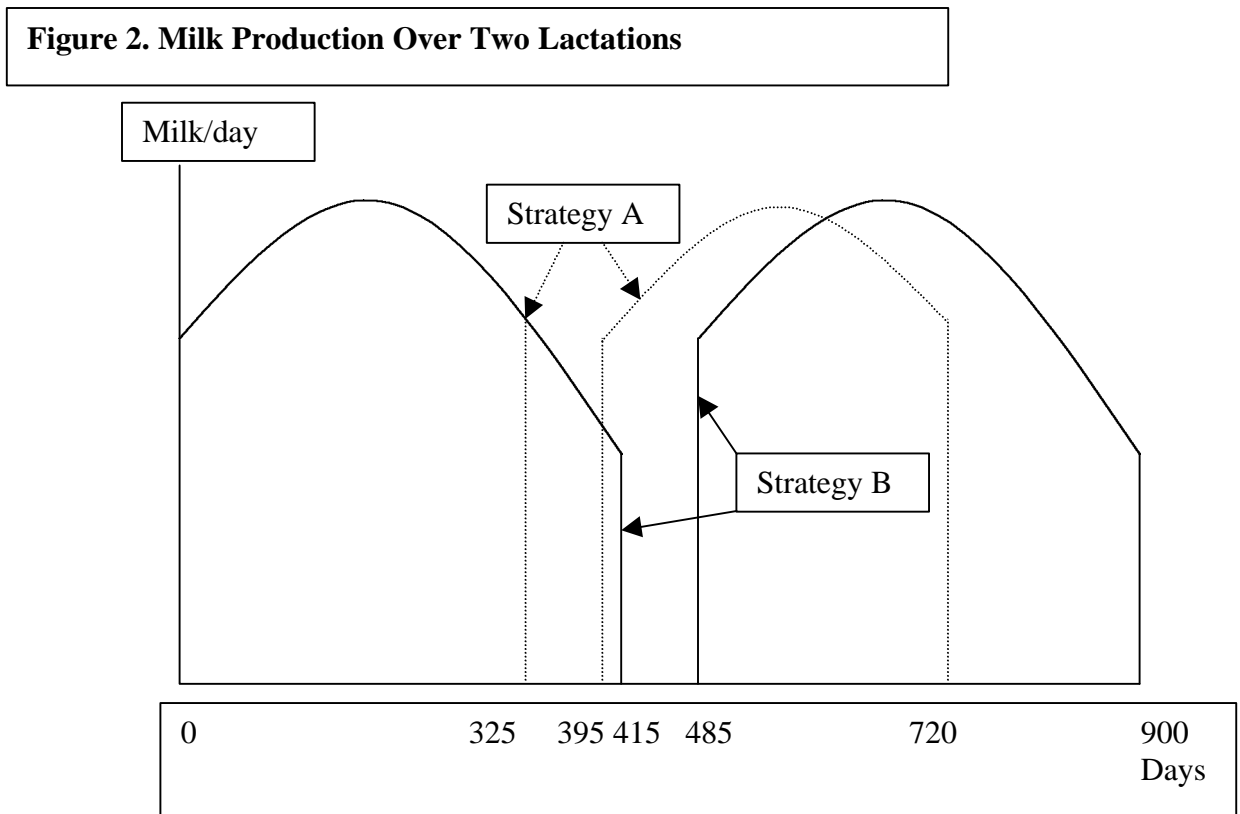
Finally, the budgets used here are “snap-shots” of the farm financial situation. One picture before the reproduction change and another after the result is achieved. We did not consider timing of expenses or revenues—just the net effect after all is said and done. We also did not consider capital investments (other than the obvious interest costs). For more sophisticated analysis, consider capital budgeting, cash flow budgets, investment analysis or some other appropriate method.

**Figure 1. Lactation Length and Milk Production**



**Table 1. Total Milk Production vs. Milk/day**

	Calving Interval	Total Milk Production	Milk/day
Strategy A	13 months	40,170	61.8
Strategy B	16 months	43,290	52.2



**Table 2. Partial Budget with \$14/cwt Milk Price****ASSUMPTIONS:**

Milking Herd Size (lactating cows only)	200
Length of Current Calving Interval (Days)	485
Length of New Calving Interval (Days)	395
Milk per Day for Current Calving Interval	52.2
Milk per Day for New Calving Interval	61.8
Voluntary Waiting Period (Days)	70
Calf Death Losses (%)	10
Feed Cost / CWT Change in Milk Production (\$)	\$8.00
Dry Cow Feed Cost / Day (\$)	\$2.00
Replacement Cost (\$/Cow)	\$1,500.00
Culling Rate (%)	30
Cull Cow Value (\$/Cow)	\$400.00
Price of Calves (\$/Calf)	\$50.00
Price of Milk (\$/CWT)	\$14.00
Interest Rate (%)	10
Extra Labor per Lac. Cow for New Situation (Hr)	4
Labor Required per Dry Cow (Hr)	5
Cost per Hour for Labor (\$)	\$8.00
Annual Vet & Med Cost Per Cow (\$)	\$105.00
Annual Supplies Cost Per Cow (\$)	\$90.00
Annual Facilities Cost Per Dry Cow (\$)	\$60.00
Average AI Cost Per Cow (\$)	\$30.00
Ovsynch Cost Per Cow (\$)	\$33.29

**HERD INFORMATION:**

	<u>CURRENT</u>	<u>NEW</u>	<u>DIFFERENCE</u>
Calving Interval	485	395	-90
Days Open	215	125	-90
Number Lactating Cows	200	200	0
Number of Dry Cows	34	43	9
Calves Born	176	225	49
Calves Sold	158	203	45
Cows Culled	70	73	3
Milk per Cow (Pounds / Year)	19,053	22,557	3,504

**REVENUES (Per Lactating Cow per Year):**

Milk Income	\$2,667.42	\$3,157.98	\$490.56
Calf Income	\$39.50	\$50.75	\$11.25
Cull Cow Income	\$140.00	\$146.00	\$6.00
Revenue Sub-Total	\$2,846.92	\$3,354.73	\$507.81



**EXPENSES (Per Lactating Cow per Year):**

Replacement Cost	\$525.00	\$547.50	\$22.50
Feed for Lactating Cows	\$1,524.24	\$1,804.56	\$280.32
Feed for Dry Cows	\$124.10	\$156.95	\$32.85
Extra Cows Investment Cost (New Situation)	----	\$6.75	\$6.75
Extra Labor for Lactating Cows (New Situation)	----	\$32.00	\$32.00
Extra Labor for Dry Cows (New Situation)	----	\$1.80	\$1.80
Extra Facilities for Dry Cows (New Situation)	----	\$2.70	\$2.70
Extra Medical Cost (New Situation)	----	\$4.73	\$4.73
Extra Supplies Cost (New Situation)	----	\$4.05	\$4.05
AI Cost	\$26.40	\$33.75	\$7.35
Ovsynch Cost	----	\$37.45	\$37.45
Cost Sub-Total	\$2,199.74	\$2,632.24	\$432.50
<b>NET RESULT PER LACTATING COW</b>	\$647.18	\$722.49	\$75.31
<b>NET RESULT FOR HERD</b>	<b>\$129,436</b>	<b>\$144,499</b>	<b>\$15,063</b>

**Table 3. Partial Budget with \$12/cwt Milk Price****ASSUMPTIONS:**

Milking Herd Size (lactating cows only)	200
Length of Current Calving Interval (Days)	485
Length of New Calving Interval (Days)	395
Milk per Day for Current Calving Interval	52.2
Milk per Day for New Calving Interval	61.8
Voluntary Waiting Period (Days)	70
Calf Death Losses (%)	10
Feed Cost / CWT Change in Milk Production (\$)	\$8.00
Dry Cow Feed Cost / Day (\$)	\$2.00
Replacement Cost (\$/Cow)	\$1,500.00
Culling Rate (%)	30
Cull Cow Value (\$/Cow)	\$400.00
Price of Calves (\$/Calf)	\$50.00
Price of Milk (\$/CWT)	\$12.00
Interest Rate (%)	10
Extra Labor per Lac. Cow for New Situation (Hr)	4
Labor Required per Dry Cow (Hr)	5
Cost per Hour for Labor (\$)	\$8.00
Annual Vet & Med Cost Per Cow (\$)	\$105.00
Annual Supplies Cost Per Cow (\$)	\$90.00
Annual Facilities Cost Per Dry Cow (\$)	\$60.00
Average AI Cost Per Cow (\$)	\$30.00
Ovsynch Cost Per Cow (\$)	\$33.29

**HERD INFORMATION:**

	<u>CURRENT</u>	<u>NEW</u>	<u>DIFFEREN</u> <u>CE</u>
Calving Interval	485	395	-90
Days Open	215	125	-90
Number Lactating Cows	200	200	0
Number of Dry Cows	34	43	9
Calves Born	176	225	49
Calves Sold	158	203	45
Cows Culled	70	73	3
Milk per Cow (Pounds / Year)	19,053	22,557	3,504

**REVENUES (Per Lactating Cow per Year):**

Milk Income	\$2,286.36	\$2,706.84	\$420.48
Calf Income	\$39.50	\$50.75	\$11.25
Cull Cow Income	\$140.00	\$146.00	\$6.00
Revenue Sub-Total	<u>\$2,465.86</u>	<u>\$2,903.59</u>	<u>\$437.73</u>

**EXPENSES (Per Lactating Cow per Year):**

Replacement Cost	\$525.00	\$547.50	\$22.50
Feed for Lactating Cows	\$1,524.24	\$1,804.56	\$280.32
Feed for Dry Cows	\$124.10	\$156.95	\$32.85
Extra Cows Investment Cost (New Situation)	----	\$6.75	\$6.75
Extra Labor for Lactating Cows (New Situation)	----	\$32.00	\$32.00
Extra Labor for Dry Cows (New Situation)	----	\$1.80	\$1.80
Extra Facilities for Dry Cows (New Situation)	----	\$2.70	\$2.70
Extra Medical Cost (New Situation)	----	\$4.73	\$4.73
Extra Supplies Cost (New Situation)	----	\$4.05	\$4.05
AI Cost	\$26.40	\$33.75	\$7.35
Ovsynch Cost	----	\$37.45	\$37.45
Cost Sub-Total	\$2,199.74	\$2,632.24	\$432.50
<b>NET RESULT PER LACTATING COW</b>	\$266.12	\$271.35	\$5.23
<b>NET RESULT FOR HERD</b>	<b>\$53,224</b>	<b>\$54,271</b>	<b>\$1,047</b>