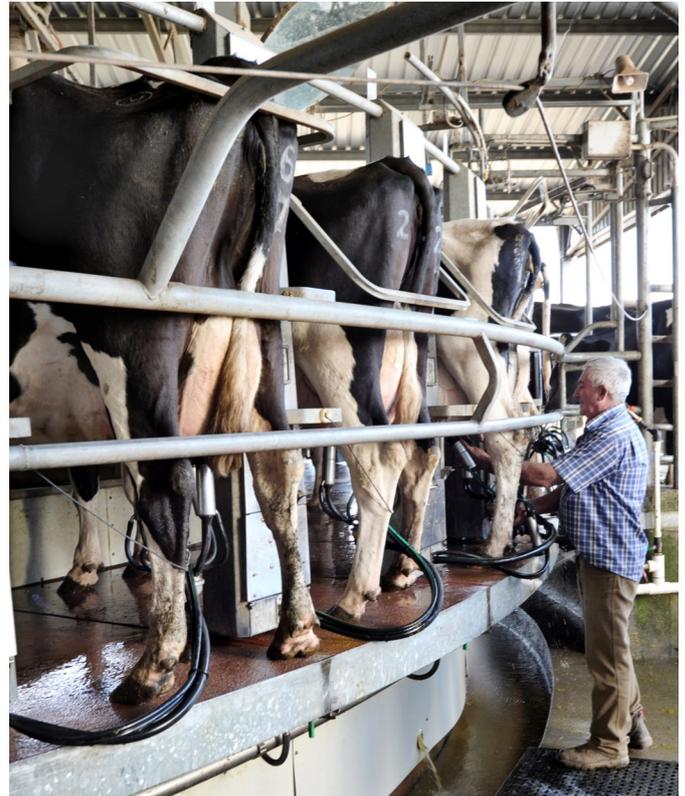


## Technical Bulletin / Dairy

# A whole-farm investment analysis of a partial mixed ration feeding system for dairy cows

### Key points

- The profit and risk of different options for feeding a mixed ration were compared using a case study farm. The options examined were to implement a partial mixed ration (PMR) system or a formulated grain mix (FGM) system. A larger herd size plus the PMR or FGM system was also tested.
- The analysis showed that increasing herd size and incorporating a PMR or FGM diet were the most profitable systems, but variability in profit increased with a larger herd size.
- The higher profit from the FGM system was the result of a milk response to mixed ration feeding that was similar to the PMR system, but without the need to pay for additional infrastructure and equipment. This presents options for farmers wanting to expand or intensify their systems without needing to construct a feed pad and invest in extra machinery and equipment.



### Introduction

A partial mixed ration (PMR) feeding system involves feeding a well-formulated mixed ration to a grazing dairy herd. A PMR system typically requires the use of specialised machinery to mix and feed out the forage and grain components of the ration together onto a feed pad.

Dairy cows fed using a PMR system have been shown to respond with an increase in milk production compared with cows offered supplements with similar amounts of metabolisable energy fed as cereal grain in the dairy and hay in the paddock.

Agriculture Victoria's Flexible Feeding Systems project recently published milk production responses to PMR feeding under Australian conditions. The project also measured the milk response to a formulated grain mix (FGM) system. In a FGM system, the same mixed ration fed in the PMR system is used, but the grain component of the ration is fed using the existing feeding system in the dairy and the hay component is fed using existing equipment in the paddock. Cows fed the FGM diet had a similar milk response to cows fed the PMR diet.

The key question for a dairy farmer is whether the income from the extra milk produced will be enough to cover the extra costs. Using a whole-farm analysis of a case study farm and milk production response data, this study investigated the profitability of a strategic decision to invest in a PMR or FGM feeding system and the impact on the variability of profit or risk.

### Case study farm (base system)

A family-run dairy enterprise located in south west Victoria was used as the base system. The farm had 244 ha of milking area and an additional 145 ha of leased land, which was used to run all young and dry stock. The production system and herd structure of the 2014-15 production year was used as the base farm for the analysis.

The milking herd of 420 Holstein-Friesian cows had a single calving period from May to July with an average lactation length of 305 days. Annual milk production was 3,363,000 litres with 133,000 kg of fat (3.9%) and 110,000 kg of protein (3.3%). Grazed pasture consumption on the milking area was 5.1 t DM/ha and supplementary feed comprised 52% of metabolisable energy requirements of the lactating cows.

### Alternative feeding systems

The base feeding system was altered to incorporate either a PMR or a FGM system.

Farmers who change to a mixed ration feeding system often intensify the business as higher amounts of supplementary feed per cow can be safely fed. An increased herd size of an extra 100 cows, plus the PMR or FGM systems was also tested.

#### Mixed ration components

The ration comprised (DM basis):

- Wheat — 38%
- Crushed maize grain — 18%
- Canola meal — 22%
- Lucerne hay — 22%

The additional capital needed to implement each system is shown in Table 1. The amount of pasture available for consumption and daily dry matter intake per cow of supplementary feed in the alternate systems was the same as for the base farm. Where herd size increased, the proportion of grazed pasture in the cows' overall diet was reduced and the amount of supplementary feed was increased.

**Table 1. Additional purchases required to change from the base system to each alternate system.**

Item	Partial mixed ration (PMR) system	Formulated grain mix (FGM) system	Base farm + 100 extra cows	PMR + 100 extra cows	FGM + 100 extra cows
Extra 100 mature milking cows			✓	✓	✓
Additional silo	✓	✓		✓	✓
Feed storage bunker	✓			✓	
Concrete feed pad	✓			✓	
Effluent system upgrade	✓			✓	
Mixer wagon	✓			✓	
Additional tractors	✓			✓	

### Extra costs

A total of \$281,000 in fixed infrastructure and \$282,000 in machinery were included as additional capital for the PMR system compared with the base farm (Table 2). The PMR system also had an additional \$28,000 in annual operating costs, reflecting the use of the feed pad and mixer wagon and the impact of additional machinery depreciation costs. In the systems with the larger herd sizes, extra repairs and maintenance, shed costs, herd costs and labour were scaled with herd numbers.

**Table 2. Estimated setup costs for the partial mixed ration feeding system, sufficient for 520 cow herd.**

Item	Cost
Concrete feed pad construction (earthworks, concrete, cow barriers, loafing area)	\$177,000
Extra feed storage capacity (silo, auto auger, storage bunker)	\$62,000
Effluent system upgrade (flood-wash, solid-liquid separation ponds)	\$42,000
New mixer wagon (20m <sup>3</sup> )	\$120,000
Extra second-hand machinery (150 HP tractor, telehandler)	\$162,000

### Marginal milk production response

Milk production responses to PMR and FGM feeding for cows in early lactation were used in the analysis. Previous analyses showed that in late lactation, it was not profitable to feed a mixed ration and it was assumed that supplements would be fed as in the base system. The estimated annual milk protein and fat production for each system is given in Table 3.

**Table 3. Estimated milk protein and fat production from the different feeding systems.**

Feeding system	Annual milk protein and fat (kg)
Base farm (420 cows)	243,000
Partial mixed ration (420 cows)	257,000
Formulated grain mix (420 cows)	255,000
Base farm with larger herd (520 cows)	301,000
Partial mixed ration (520 cows)	324,000
Formulated grain mix (520 cows)	322,000

### Measuring profit

The performance of the existing farm and alternate systems were assessed using whole-farm discounted net cash flow budgets over the 10-year period.

Each year of the 10-year budgets were run with a range of milk prices, feed prices and pasture consumptions to reflect the variability in operating conditions that the farm may experience. The standard deviation calculated from the 10-year budget represented risk or the amount of variation in profit.

### Results

A comparison of the base farm and alternate systems is given in Figure 1. Implementing a PMR feeding system was more profitable than the base system over a 10-year period because the milk response and increase in milk income from feeding the mixed ration could cover the cost of extra annual feed, labour, depreciation, and repairs and maintenance.

The FGM system was more profitable than both the base and PMR feeding systems (Figure 1). The higher profit for the FGM system was the result of a milk response to mixed ration feeding that was similar to the PMR system, but without the need to pay for extra labour, depreciation and repairs and maintenance costs for the extra infrastructure and equipment. This presents potential

#### Key measures of profit used

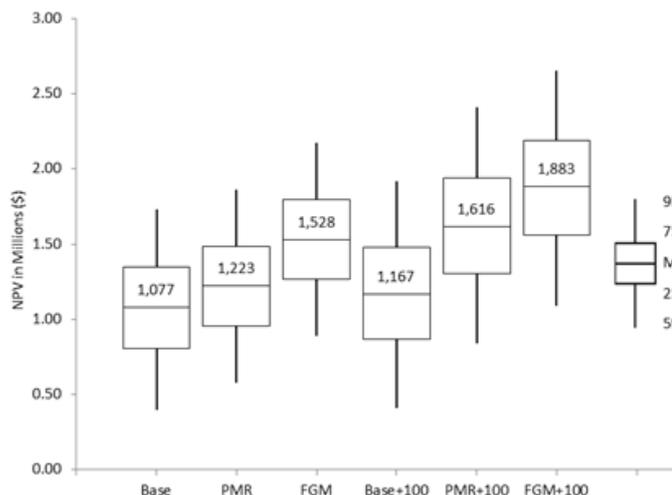
**Net present value (NPV) at a real discount rate of 5%:** is the sum of profits in present-day dollars earned over the life of the investment after allowing for a 5% real opportunity cost.

**Modified internal rate of return (MIRR):** is the average earning rate over the 10-year analysis period.

options for farmers wanting to expand or intensify their systems without needing to build a feed pad and invest in the additional equipment.

Increasing herd size and incorporating a PMR or FGM diet were the most profitable of the systems analysed (Figure 1). For the larger herd sizes, milk income rose proportionally more than overhead costs, and profit increased as overhead costs per kg of milk protein and fat produced decreased. A lower proportion of grazed pasture also made up the diets of cows in the larger herds, which increased the proportion of supplementary feed and led to a higher milk production response for the PMR and FGM systems. But an increased reliance on the supplementary feed market in systems with the larger herd sizes resulted in higher risk, or variability in NPV and MIRR, compared with the base herd size.

(a) Net present value at 5% discount rate



(b) Modified internal rate of return

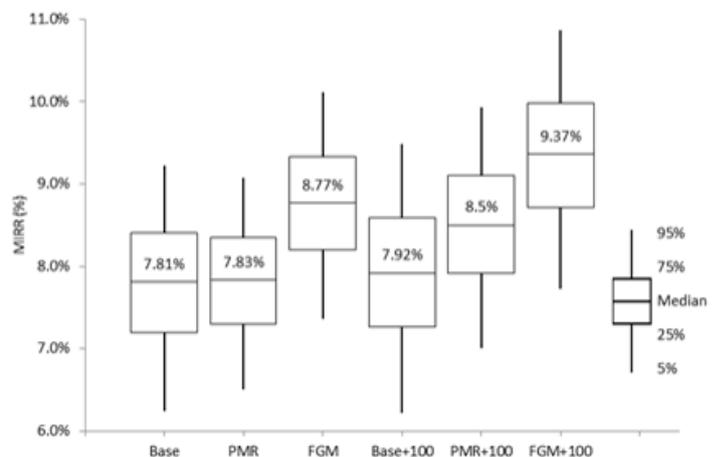


Figure 1. Box and whisker plot of median and key percentiles for (a) net present value (NPV) at 5% discount rate and (b) modified internal rate of return for the base system, partial mixed ration (PMR) system, formulated grain mix (FGM) system and where herd size was increased by 100 cows.

#### Box and whisker plots

The size of the box indicates variability or risk associated with a feeding system and measures the spread of the middle 50% of data. The whiskers show 40% of the data that falls outside the middle 50%. Together, the box and whiskers indicate 90% of results from the analysis.

## Summary

- All alternate systems were more profitable than the base farm with the PMR or FGM feeding systems the most profitable of the options analysed, but intensifying the system by increasing herd size also increased risk.
- The FGM system was the most profitable option as milk production and milk income could be increased without incurring the costs for extra labour, depreciation and repairs and maintenance associated with using a mixer wagon to feed the ration.



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