



## Benefit Cost Study of Increased Holstein-Friesian Jersey Crossbred Dairying in Victoria

By

**Bill Malcolm**

University of Melbourne

and

**Chris Grainger<sup>1</sup>**

Department of Primary Industries Victoria

---

<sup>1</sup> Many knowledgeable people have given us advice in conducting this analysis. In particular, we have had extremely valuable advice about many of the intricate and subtle angles associated with crossbred dairying from Bill Fulkerson, Mike Goddard, Jock McMillan, Mike Pyman, Ian Gibb, John Morton, Sandy McLintock. However, they are not to be held responsible for the analysis, results and conclusions. The authors alone are to blame.

# **Benefit Cost Study of Increased Holstein-Friesian Jersey Crossbred Dairying in Victoria**

## **Executive Summary**

In this study, budgets of herd dynamics, feed and energy supply, production and profit of alternative dairy farm systems were used to examine the effects of changing a 230 cow Holstein-Friesian (HF) dairy system to a Holstein-Friesian Jersey (HFJ) crossbred dairy system. In the comparison of the two dairy systems the energy supplied to the 230 cow HF system was kept the same in the HFJ system. With HFJ cows weighing 90% of the HF cows, 242 HFJ cows were able to be milked. If both herds produced milk, fat and protein at the national herd average for their breed, then the 242 cow HFJ herd produced \$12,000 higher operating profit before tax, per annum, than the equivalent 230 cow HF herd. The gain in operating profit came from increased fat and protein produced from the farm energy supply as a result of less energy used in maintenance energy costs of the HFJ herd, and a reduced volume penalty. There was also some gain from the HFJ cows having superior reproduction performance that enabled a different herd age structure and thus lower herd depreciation and costs of feeding replacement heifers. If a feed conversion efficiency advantage of 3% existed for the HFJ cows over the HF cows, the gain in operating profit over the HF herd was estimated to be \$18,000 before tax per annum.

The potential aggregate gains from a proportion of the current Victorian HF dairy herd being converted to HFJ herds was estimated for a 30 year planning horizon. If 20 per cent of the current HF herds were changed to HFJ herds at a steady rate over 15 years, the present value of the net gains sum to \$200m, or an annuity of \$11m, at a rate of time preference (discount rate) of 4% pa. At a research risk adjusted discount rate of 25 per cent and no FCE advantage for HFJ cows, the present value of the net gains from a change in the relative proportions of the Victorian dairy herd such that 20% of herds become HFJ herds over 15 years, the benefits are estimated to be \$23m (annuity \$1.3m for 30 years). If the same adoption occurred over 10 years, benefits are \$33m (annuity \$1.9m over 30 years) at 25% discount rate.

The results from this investigation suggest for some dairy farm systems that are currently operating as HF systems there is likely to be some advantage in changing to HFJ crossbred dairy systems. As well as potential gains in annual operating profit, the scope for further gains, both pecuniary and non-pecuniary, from changes to the farm system that can be brought about by improved reproduction performance of HFJ cows, such as changing from split calving to single seasonal calving and improved feed utilization is also likely to be significant for dairy farmers in some situations.

As well, there seems to be a reasonable probability that superior feed conversion efficiency of HFJ cows over HF cows would be a sound source of productivity gains that, in the face of rising real costs of production and static or falling real milk prices, could help maintain or add to profits in some dairy systems across Australia.

# Benefit Cost Study of Increased Holstein-Friesian Jersey Crossbred Dairying in Victoria

## Introduction

The current dairy herd in Australia comprises a mix of 83 per cent Holstein-Friesian (HF), 12 per cent Jersey and 5 per cent Holstein/Friesian X Jersey (HFJ) crossbreds. In this study, the question is investigated whether there are economic benefits to be had in some dairy herds by changing from dairy herds currently made up of Holstein/Friesian cows to Holstein/Friesian X Jersey crossbred cows.

Changing a HF dairy herd to a HFJ crossbred herd would have implications for the way a farm system performs in the following main areas:

- (i) Conversion of farm energy supply to particular quantity and quality of saleable product
  - liveweight carried per hectare
  - feed utilization
  - feed production
  - net feed efficiency of feed conversion
  - total milk yield and income
  - fat, protein, lactose, volume produced
  - somatic cell count
- (ii) Choice of farm system
  - seasonal calving
  - split/batch calving
  - year round calving
  - use of extended lactations
  - grass and grain mix in total feed supply
  - grazing based or lot fed
- (iii) Herd reproduction performance
  - in calf rates over a range of length of mating periods
  - calving interval
  - submission rate
  - conception rate

- lifetime calves produced
- lifetime lactations
- (iv) Animal health
  - dystocia, post calving diseases, metabolic diseases, lameness, survival rates
- (v) Herd age structure and dynamics
  - not in calf cull rates
  - cull rates other than not in calf
  - age distribution of herd and production per head
  - longevity of cows

Flowing from changes to the performance of a farm system that might result from the above changes in herd performance are potential changes in profit, with labour, management and non-economic implications too. Some implications for dairying systems and the people who run them may not be readily quantifiable into dollar terms but can be significant factors nevertheless.

- (vi) The question to be answered is:

What are likely to be the main implications of a change in the current composition of the Victorian Dairy Herd to a lesser proportion of Holstein/Friesian cows and a greater proportion of Holstein/Friesian-Jersey crossbred cows over the next 30 years?

Important possible changes that may have significant economic impact for any given system will be to do with energy production and utilization, milk production and composition, herd reproduction performance, changes in herd structure and dynamics, and animal health. The major implication may manifest itself in the way a change away from a purebred Holstein/Friesian based herd to an Holstein/Friesian X Jersey crossbred herd facilitates some substantial change in the whole farm system, such as a change from split calving that is practised because of reproduction difficulties with a HF herd to a seasonal calving system with a HFJ crossbred herd, made possible by say, improved reproduction performance of the crossbred herd. This is but one possible example amongst many. There are as many possible changes to farm systems, as there are existing dairy farmers and dairy farm systems.

Investigating the implications of changes to the composition of the dairy herd in Victoria involves looking at the question from a number of angles to try and form a rigorous view about the overall effects of a change in herd composition, using applications of the techniques known as Farm Systems Modelling and Benefit Cost Analysis. Assessing the merit of a change to the way some part of the economy operates requires that the counter-case is defined. That is, the situation that is expected to prevail without the change is defined. Then the situation that is expected to prevail with the change is defined. Then the base (unchanged) and the changed cases are compared to help form

a view about the differences between the farmers and the base case and the changed case and whether the differences amounts to a net benefit to society.

To conduct such a comparison it is necessary to evaluate impacts of change from milking HF herds to HFJ herds at the levels of some typical dairy farm operations, and then to extrapolate from these samples to the larger population.

### **Investigating the profitability of a dairy system running Holstein/Friesian cows and comparing it with the same system running Holstein/Friesian-Jersey cross cows.**

The method used was as follows:

First the operation of an actual dairy farm milking 230 split calving Holstein-Friesian cows was modelled. The Kyabram future farming systems model and a real case study farm was used (Armstrong *et al* 2002). This model has a detailed energy budget of animal requirements.

The key parameters of the dairying system on an annual basis were:

- Herd size
- Milk production, fat and protein
- Liveweight per cow. HFxJ 90% of HF
- Total energy quantity supplied to herd and per cow
- Energy used for non-milk and fat production (maintenance, pregnancy, exercise, change in body weight, replacements)
- Energy supplied for milk and fat per cow and per herd
- Shed costs/hd, feed costs/hd, herd costs/hd, overhead costs
- Reproduction performance, herd cull rates
- Fat and protein prices and volume charge were included
- Livestock trading profit
- Farm operating profit

The 230 cows in the case study HF herd produced an average of 6,546 litres/hd and 257 kg fat/hd (3.9%). Protein was 3.2%, 210 kgs/hd. Total milk production was 1,505,350 litres, 59,100 kg fat and 48,292 kg protein. The protein:fat ratio was 0.82. Price received was \$2.34/kg fat, \$5.84 kg protein and -0.028 volume adjustment. This came to \$6.41/kg butterfat equivalent. Price per kg MS was \$3.52. Price per litre was \$0.25. Operating profit was \$36,000.

The herd structure was:

- 1yo 55
- 2yo 50
- 3yo 50
- 4yo 50
- 5yo 60
- 6yo+ 20
- Total milkers 230

The cull rate of the HF herd was 24% pa. This is derived from a conception rate of 85% over a 9 week mating period (62% in calf after 6 weeks). This gives a not-in-calf cull rate of 15%, plus another 10% culled for other reasons.

The next step was to run this dairy farm model in the same manner, with the same feed supply (same total energy supply), but with HFJ cows producing at the Victorian crossbred herd average of 5,844 litres of milk, 253 kg fat (4.3%), 201 kg protein (3.4%) (Pyman 2003). For this case, because heifer rearing feed costs are part of the farm total costs, it is implicit that the HFJ herd numbers are maintained by annually retaining, agisting and growing out HFJ x J or HFJ x HF back-cross heifers that perform similarly to the HFJ cows. However, conceptually and practically the cow numbers in the system could be maintained by purchasing crossbred replacement heifers for similar cost to the farm system as rearing own replacements (sometime in the future when such a market develops).

Prices used in the analysis were fat \$2.34, protein \$5.84 and volume charge \$-2.8 c/litre, giving \$6.33/kg butterfat equivalent for the HFJ herd. Price per kg. of Milk Solids was \$3.53. Price per litre was \$0.27.

The HFJ cows were assumed to weigh 90% of the bodyweight of the HF cows (Auldish and Grainger, 2004). The farm energy supply that is not required for maintenance of the HFJ cows compared to the heavier HF cows is available to carry more cows that produce at the national HFJ herd average fat and protein production. According to the model of the case study farm, using the substitution rate of 90% of HF liveweight, a total of 242 HFJ cows could be run, each producing 5,844 litres of 4.43% fat and 3.43% protein. The protein:fat ratio was 0.78. The energy spared from maintenance energy costs of the lighter HFJ cows leads to an improvement in feed conversion efficiency (FCE) of 2.31% (Table 2) because the energy can then be used to run extra HFJ cows. The 242 HFJ cows produce a higher total farm milk solids production than the 230 HF cows.

As the change in HFJ cow numbers milked for this farm system initially comprising 230 HF cows is marginal, this farm has the existing infrastructure and labour to handle the extra cows. However,

with larger herds and larger increases in herd from conversion to HFJ cows, extra labour and capital investment would be required (this situation is accounted for in the Benefit Cost Analysis that follows later for the national herd).

The different milk production by cows of different ages in the HFJ herd, and different reproduction performance as cows age, is accounted for by using the average litres/head and average reproduction performance, of herds surveyed by Pyman (2003). These herds comprise cows of a range of ages, thus the age-production affects are incorporated in the average.

At an annual replacement rate of 20 per cent, the steady state herd structure was:

- 1yo 45
- 2yo 42
- 3yo 46
- 4yo 45
- 5yo 45
- 6yo+ 63
- Total milkers 242

An improved reproduction and longevity performance of the HFJ cows was accounted for by changing the age composition of the HFJ herd (more older cows) and reducing the overall cull rate from 24% for the HF herd to 20% for the HFJ herd. The crossbred herd cull rate derives from 90% in calf after 9 weeks mating (68% in calf after six weeks). This gives an 11% not in calf cull rate plus another 11% culled for other reasons. The economic effect of different herd cull rates is to change the herd structure, with different numbers of sale animals (culls and calves), and less one year old heifers and calves required.

The results for the 242 HFJ Herd (90% of HF liveweight) with the same farm energy supply were:

- 5,844 litres of milk per head, total milk production 1,414,248 litres
- 4.43% fat, 249kg fat/hd, total fat 61,226 kg
- 3.4% protein, 201 kg protein/hd total protein 48,642 kg
- Operating Profit was \$48,000
- Gain over Holstein/Friesian herd was \$12,000 (before extra income tax)

The protein:fat price in the analysis was \$5.84:\$2.34; ratio of 2.5:1. At a protein:fat price ratio of 5:1 (\$7.20/kg protein, \$1.45/kg fat, \$6.63/kg butterfat equivalent for HF, \$6.52/kg butterfat equivalent for HFJ), the 90% LW HFJ herd profit was \$62,000 and the HF herd profit was \$49,000.

At a protein:fat ratio of 5.27:1 (\$7.65 /kg protein, \$1,45/kg fat, \$7/kg fat equivalent for HF, \$6.88/kg fat equivalent for HFJ), the HF herd profit was \$71,000 and the HFJ herd profit was \$84,000. The net profit advantage of the HFJ herd over the HF herd, at a significantly higher price of protein to price of fat ratio, increased only marginally because of the higher MS production of the HFJ farm stocked with 242 cows compared with the HF farm stocked with only 230 cows.

A consideration is that the total capital tied up in the HFJ herd is less than the HF herd because there are less replacements retained. Average livestock capital tied up in the HF herd with 24% replacements is \$240,000. For the crossbred herd with 20% replacements this figure is \$200,000. As mature animals are valued approximately in line with their liveweight and age, the difference in total herd capital between the HF and HFJ herds for the 90% HFJ liveweight substitution rate is mostly to do with the capital tied up in 1 year old and 2 year old replacements. The opportunity cost of 8% on a capital difference of \$30,000 would come to \$2,400. However, it is arguable that if HFJ cows had some benefits in productivity and profitability in some systems over alternative cows, then the capital value of HFJ cows will be bid up to reflect this, and apparent differences in capital tied up in such herds would not exist.

Note the analysis here is for an established HFJ whole herd with steady state structure, and the transition process has not been considered. Having established that for some systems the idea of converting from a straight-bred HF herd to a crossbred HFJ herd might be worth closer investigation, the details of the alternative paths of transition need to be analysed closely. With such changes the more rapidly the transition is achieved and the sooner the benefits received, the more profitable the change will be.

In Figure 3 is shown the breakdown of the contributing parts to the overall gain of \$12,000 estimated to apply in this case comparison. The largest components of the gain from the HFJ herd compared with the HF herd are the extra income from extra fat and protein, around \$4,500 and \$2,500 respectively. Saving on the volume penalty is also significant, around \$2500. There is a saving of \$8,000 in feed costs associated with carrying and rearing less replacement heifers. This happens because of the different herd structure; there being more cows that are older and less annual culls of cows that are not in calf. However, much of this feed saving is offset by \$6,000 less trading profit from less sales of cull cows and less reared calves to one year old heifers to springing heifers, with more sales of young calves.

It appears that in the 230 HF dairy cow system investigated, a change to a HFJ herd with 90% of the bodyweight of the HF cows and with consequently lower total energy requirement for non-milk production (total of maintenance, pregnancy, body weight change, exercise energy requirement,

replacement energy requirements) and able to produce more fat/litre and more protein/litre, and with a lower replacement rate of not-in-calf cows, may result in an increase in annual operating profit (before extra tax) of the order of \$12,000 (before extra tax) more than the HF operating profit.

In Table 1 is shown results for the 230 cow HF herd and for HFJ herds for a range of liveweight substitution rates. In Figure 1 is shown the operating profit for a range of liveweight substitution scenarios. In Figure 2 is shown total farm liveweight for each of these scenarios. If the HFJ cows are smaller animals than the assumed 90% of HF cows liveweight used in the above analysis, the gain in operating profit increases. At HFJ cows 85% of HF cows liveweight, 245 HFJ cows are milked and operating profit is \$51,000, a gain of \$15,000 before extra tax. If HFJ cows are 83% of HF cow liveweight, 247 HFJ cows are milked and produce an operating profit of \$55,000, a gain of \$19,000 before extra *tax*. At 78% LW, 251 HFJ cows are milked and operating profit is \$61,000 and the gain is \$25,000.

Table 1: HF-HFJ Comparison: Production and Profit

	Oper- ating Profit	Gain Before Extra tax	Milk Litres	Fat kgs	Protein kgs	MS kgs	Energy/yr MJ	Live Weight kgs	Extra cows
Friesian 230	36000	-	1505350	59100	48292	108415	14508098	126500	
90%LW 242	48000	12000	1414248	61226	48642	109868	14508098	119790	12
85% LW 245	51000	15000	1431780	61985	49245	111230	14508098	114538	15
83% LW 247	55000	19000	1443468	62491	49647	112138	14508098	112756	17
78% LW 251	60000	24000	1466844	63503	50451	113954	14508098	107679	21
3% FCE gain 246 90% LW cows	54000	18000	1437624	62238	49446	111684	14508098	121270	16

Figure 1: Farm Operating Profit and Gains

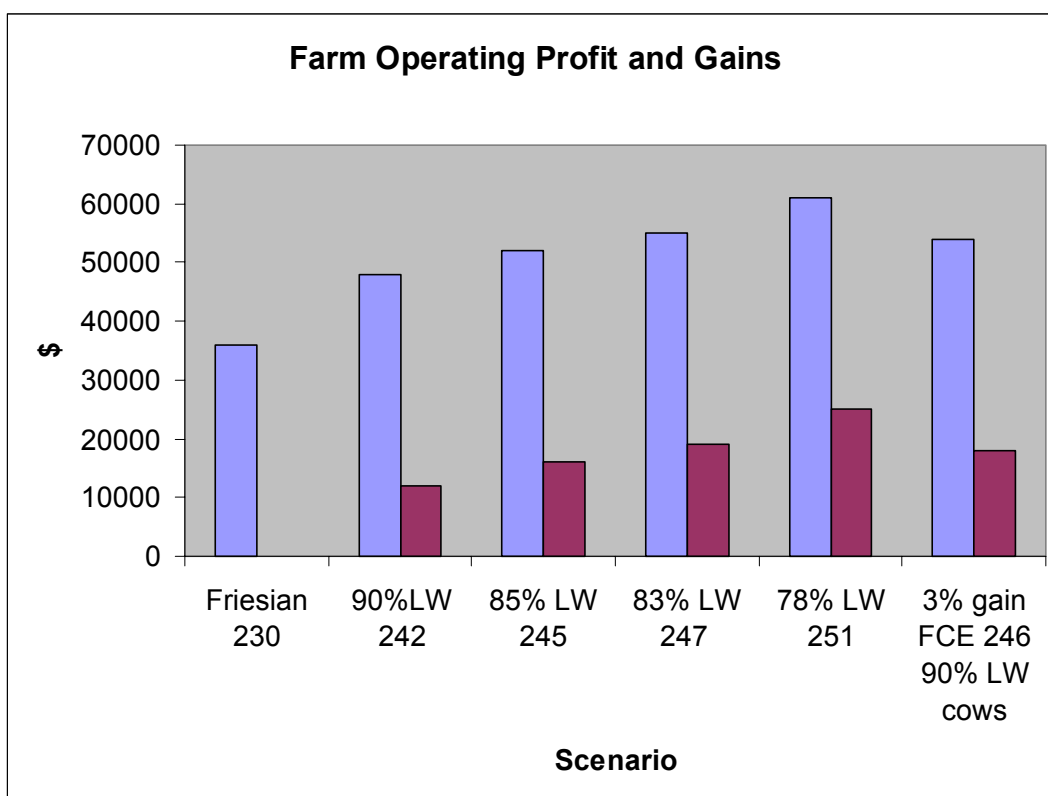


Figure 2: Total milk, fat, protein, milk solids produced

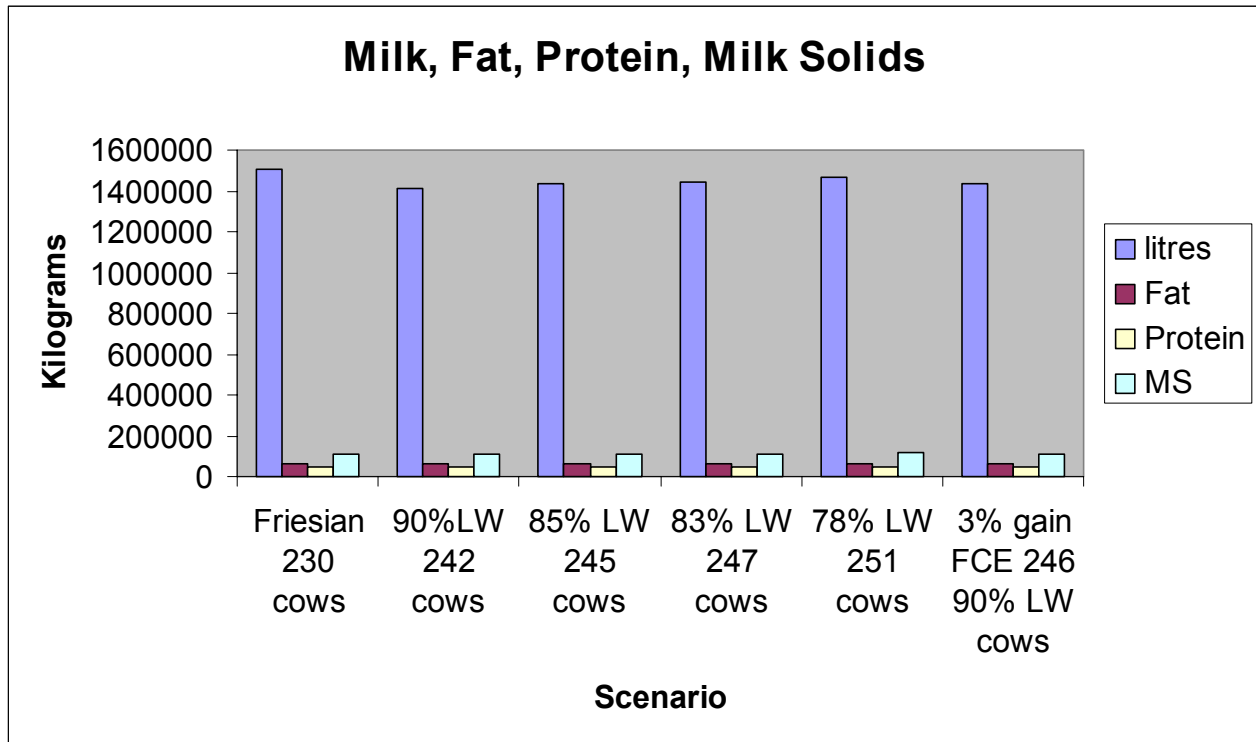


Figure 3: Components of total \$12,000 HFJ gain over HF herd

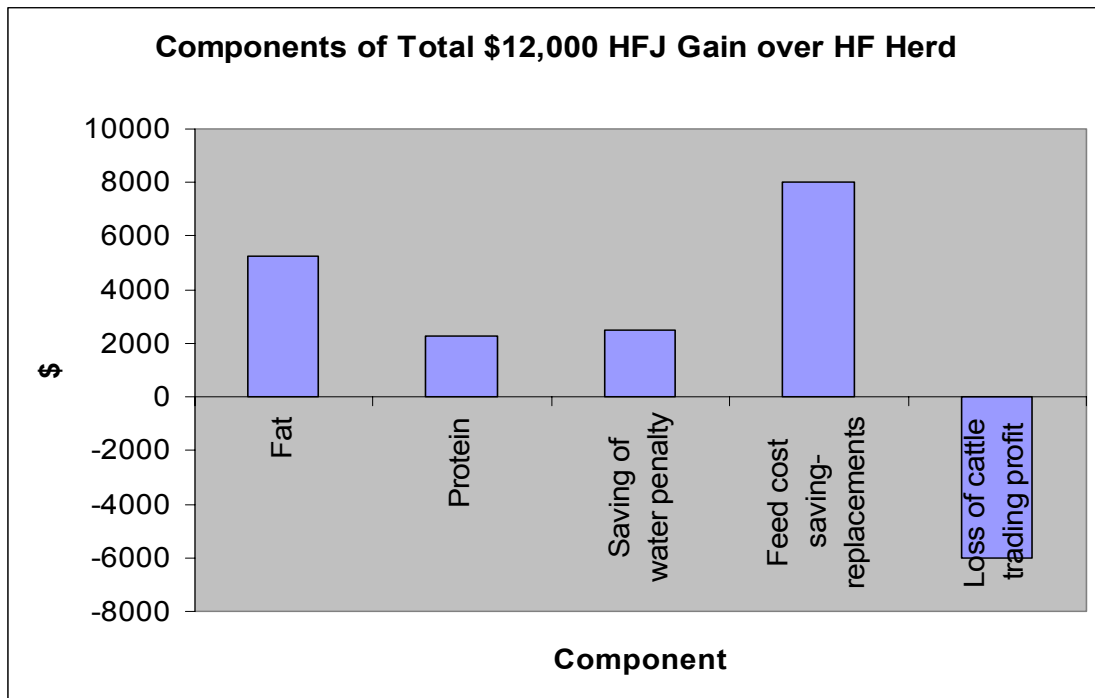
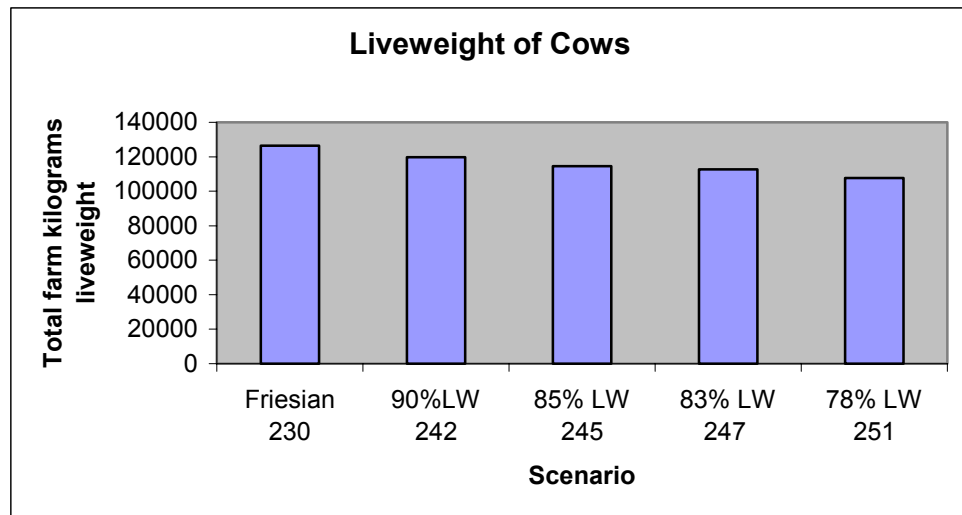
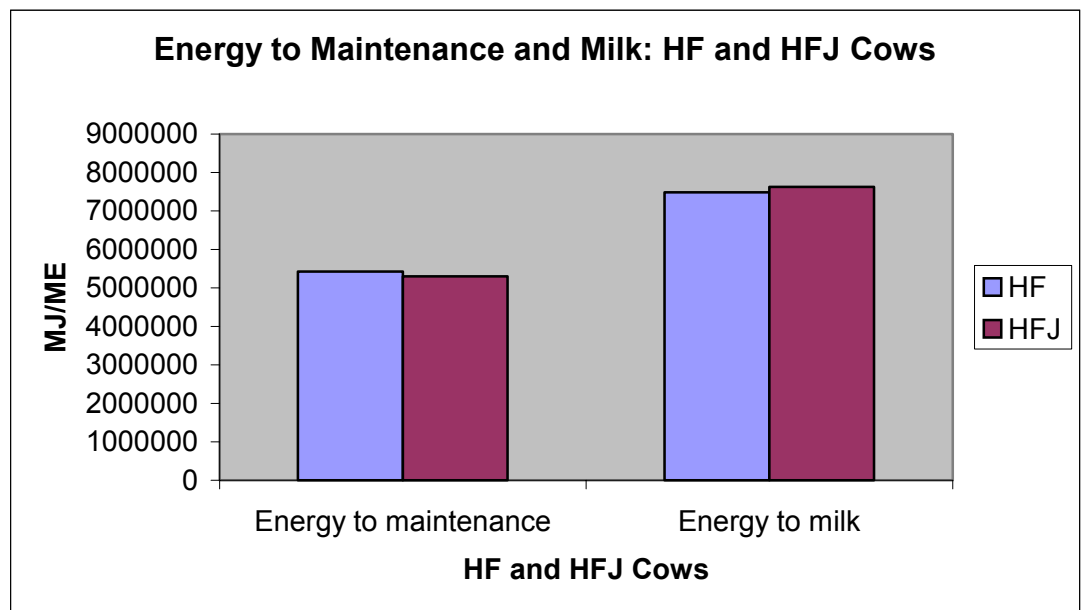


Figure 4: Total farm liveweight of cows



In Figure 5 is shown the different major uses of energy in the two systems, HF and HFJ.

Figure 5: Comparison of major uses of energy, HF and HFJ systems



Slightly less energy is required for maintenance of the HFJ herd than the HF herd, and therefore slightly more energy goes into producing less litres of milk but with a higher fat and protein content and an overall higher total yield of milk solids.

### Comparing some indicative technical efficiency ratios and profits

From a meta-analysis of research about feed conversion efficiency of dairy cows, Grainger and Goddard (2004) have started to make the case that it is possible that efficiency of feed conversion, measured as kg.MS/kg.DM, could differ between HF and HFJ cows. They report results from published research comparisons of kg.DM/kg.LW and kg.MS/kg.DM and kg.MS/kg.LW for HF and Jersey cows.

They concluded Jersey cows ate more DM per kg LW than did Friesian and Holstein cows (7.6% more for NZ and 14.4% for the USA). Higher intake per kg of LW can lead to higher MS per kg. of LW.

Grainger and Goddard (2004) reported that Jerseys had an average 23% higher ratio of kgMS/kgLW than did HF cows. When FCE was expressed as kg.MS/kgDM, Jersey cows averaged a kg.MS/kg.DM ratio that was 6.2% higher than Friesians and Holstein. The 23% advantage in MS/LW for the Jerseys reported in the literature would equate to an 11.5% advantage in MS/LW over the HF for the HFJ crossbreed cows.

In Table 2 the above-mentioned technical efficiency ratios are shown for these feed conversion ratios of the case study HF and HFJ herds.

*Table 2: HF and HFJ Comparison - Feed Conversion Indicators*

<b>FCE Ratios</b>	<b>Gms MS/kg DM whole year</b>	<b>% Difference HF base</b>	<b>Whole year kgDM/kgLW</b>	<b>% Difference HF base</b>
Friesian 230 cows	79.31		10.70	
90% LW 242 cows	81.14	2.31%	11.30	5.60
85% LW 245 cows	82.15	3.57%	11.82	10.44
83% LW 247 cows	82.82	4.42%	12.01	12.10
78% LW 251 cows	84.16	6.11%	12.57	17.48
3% gain FCE 246 90% LW cows	82.87	4.49%	11.07	3.40

The interpretation of these ratios is as follows. In the HFJ 90%LW 242 cow scenario, an overall advantage of FCE was calculated to be 2.31% higher than the 230 HF cow system. In this scenario, it was assumed that the HF and HFJ cows had the same requirements of energy for maintenance per unit of liveweight and energy requirements for milk solids were based on the energy in milk derived from the composition of fat and protein in the milk of HF and HFJ cows. The FCE advantage of the HFJ cows in this scenario comes from more, slightly lower LW cows, and allocating the energy not required for maintenance to fat and protein production. Another scenario was to assume that the 90% LW HFJ cows also had an advantage in FCE of 3% over the HF cows. To do this the feed supply was set at 1.03 times the

original supply to see how many extra 90% LW HFJ cows could be fed. In this scenario, an extra 4 cows could be fed to produce milk solids at the HFJ average, over and above, the 90% LW 242 cow scenario. The total HFJ advantage over the HF cows in FCE was then calculated to be 4.49%. This is the combined effect of lower LW and using excess energy for fat and protein, and also a 3% higher FCE.

The estimated gain in annual operating profit of \$12,000 is for the 90% LW, 242 cow farm (12 more cows than the 230 HF case) where there is a 2.31% HFJ advantage in FCE, due to less energy required for maintenance, that can then be used for running more cows that produce MS at the HFJ average. Included in this \$12,000 extra profit is cost savings because of a lower replacement of not-in-calf cows in the HFJ herd. The \$12,000 profit may well be a conservative estimate as there is evidence from Grainger and Goddard (2004) suggesting that there could be a higher FCE advantage for HFJ cows over HF cows. If true, then this would make the estimate of \$12,000 HFJ gain in annual operating profit for the farm system in question, a conservative estimate. Running the HFJ model such that the FCE was 3% higher than the HF cows meant that less energy was required to produce MS with HFJ cows compared to the HF cows. This spared feed energy on the farm could then be used for running 16 extra HFJ cows producing at the average production for HFJ cows. This resulted in an operating profit of \$54,000; a gain over the HF herd of \$18,000 before extra tax over the HF case, and an extra 4 cows and \$6000 extra operating profit over the 242 HFJ cow case.

In this analysis, the crossbred herd had higher FCE than the HF herd, at values similar to and consistent with those reported in the literature by Grainger and Goddard (2004). The differences between the FCE ratios for HF and HFJ cows cited in the literature were most reasonably approximated in this analysis by the HFJ cows that were 90% of the HF cow liveweight. For the benefit cost analysis that follows for the whole of Victorian herd, HFJ cows weighing 90% of the HF herd are used as the basis for the estimate of extra annual operating profit from HFJ crossbred dairying. This results in an increase in annual operating profit of \$12,000 before extra tax for the 230 HF herd that changed to an HFJ operation. After income tax at 20%, this gain would be \$9,600.

### **Points to Note about the Comparison**

Effects on pasture production and utilization of the higher stocking rate of the crossbreeding system are not taken into account. This is likely to be important as it could lead to a higher pasture utilisation.

No extra capital investment in infrastructure or extra labour is involved to run the additional cows. However, a larger herd of say, 600 cows that changed to HFJ cows with the same feed supply could be milking an extra 50 cows or more. This would require half an extra labour unit (\$12,500), and probably some capital investment in infrastructure. If the \$12,000 advantage of HFJ cows in the 230 cow HF case study farm were simply scaled up (though reality is not usually as simple as this) the 800 cow operation could increase operating profit before extra labour by \$42,000 and \$30,000 after extra labour (but before any amortized annual extra capital costs for extra infrastructure investment). The economics of converting a real case of a larger sized operation than the 230 cow case study investigated in this report warrants analysing.

The appropriate liveweight conversion for HFJ cows as a percentage of HF cows is a critical issue. Empirical survey data for Victorian herds suggests average crossbred cows weigh 92% of average HF cows (Grainger and Auldist (2004), unpublished). Evidence from the UK and NZ suggests ranges of HFJ:HF cow liveweight percentages from 75% to 90%. In practice, in future, animals of the size that promise to give the greatest gain would be developed and used.

Direct herd health and reproduction costs are the same for the crossbred herd as for the HF herd (though anecdotal information strongly suggests these could be lower for the crossbred cows).

No allowance has been made for milk quality effects, though there could be some lower cell count advantages of crossbreds over HF cows.

The detail of the breeding system that would be followed in the crossbreeding herd has not been accounted for in the analysis. That is, in practice, many crossbred herds would move from first cross to cross back and forwards towards either breed. The results of this analysis could be interpreted as though the crossbred herd was replaced by buying in first cross heifers as required each year. (This simplifies the analysis, eschewing the need to analyse a herd that may be part straight-bred and part crossbred, with the straight-bred cows used to produce replacement heifers, for instance).

A further point to note is that there is some suggestion in the research results investigated by Grainger and Goddard (2004) that a HFJ cow may have lower maintenance requirements per kg. liveweight (metabolic liveweight;  $LW^{0.75}$ ) than that of HF cows. This could lead to higher feed conversion efficiency because energy spared from maintenance could be used for milk production.

Importantly, often significant benefits come from the way a change in part of the system (e.g. less reproduction and animal health problems) enables other changes to be implemented in particular systems, with associated pecuniary and non-pecuniary benefits. For instance, in the case investigated in this analysis, the system could be able to be changed to a tight seasonal system if the crossbreds can get in calf better than the HF. Such a change could enable overall profitability of the system to be at least maintained and most likely improved. Apart from the profit angle, for some farm families there could be significant but non-pecuniary benefits associated with being able to operate a tight seasonal calving system.

A potentially very significant result of a change to crossbreds that facilitated a change to a tight seasonal calving system could be a better match of herd requirements to pasture growth patterns. This has the potential to make extra feed energy available as the result of improving pasture utilisation – a potentially significant productivity gain. Better production and pasture utilization could also result from running a system with an increased stocking rate, cows with lower bodyweight, and that may have in some respects some different grazing behaviour, e.g. better tolerance to heat, higher consumption per unit liveweight.

### **3. Benefit Cost Analysis: Increased Proportion of Crossbred Cows in Victorian Dairy Herd**

Findings from the detailed analysis of typical farm systems outlined in Section 2 form the basis for extending the analysis by posing the question: ‘What if the proportion of crossbred dairy cows in the whole Victorian dairy herd was to increase to some extent over time?’

So far the net benefits from changing a typical 230 cow dairy farm system milking HF cows to a crossbred HFJ system have been estimated. The estimated net monetary benefits of \$12,000 per 230 cow HF herd from changing a 230 HF cow herd to a 242 HFJ crossbred herd forms the basis for investigating possible effects of wider adoption of the cross-breeding system across the Victorian dairy herd.

## Method

The past and current number of herds in Victoria and distribution of herd sizes is used to estimate a possible future distribution of numbers and sizes of dairy herds over the 30 year planning horizon. Thus the number and sizes of herds comprising the Victorian dairy herd is anticipated to continue to change over the ensuing 30 years in a way similar to the way it has changed since 1974. The pace of change could be different though. For this analysis, the distribution of herd sizes, and numbers of herds in year 30, are assumed to have changed in ways similar to the changes that have occurred over the past three decades. Thus, by year 30, average herd size will have doubled the current size, and the number of herds will have halved, as happened in the past decades<sup>2</sup>. For the analysis, the rates of these changes are a constant linear rate over the entire period.

A changed distribution of herds for Victoria is hypothesized to be as follows:

All dairy cows:			
Current		Future	
Average Size	Number Herds	Average Size	Number Herds
200 cows	3200	250 cows	800
300 cows	1600	600 cows	600
650 cows	200	1000 cows	500
Total 1,125,000	5000	1,300,000	2,300

Crossbred dairying currently suits some dairy systems in Victoria. In the future, it could suit a higher proportion of the dairy farms in Victoria. In the Benefit Cost Analysis, the focus is on the 83% of the herds that are currently HF cows and the possibility that some of these herds could change to be a HFJ herd over the next 15 years. Benefits from changing a 230 cow HF operation to an equivalent herd (in terms of feed demand) are applied to a range of proportions of farms in each of the size categories, over a period of 15 years when full adoption is assumed to have occurred. The change is then carried on until year 30.

The change adopted would involve a range of HFJ cow liveweight. Currently, crossbred cows average around 90% of the liveweight of HF cows. Benefits from

cows weighing 90% of HF cows are used in the benefit cost analysis. This benefit is a before tax \$12,000/230 cow HF herd that changes to HFJ cows. For larger herds, the number of extra crossbred cows to be milked is significant enough to require extra labour. This is allowed for in the analysis.

Changing HF herds to HFJ herds involves increases in stocking rate that not only require extra labour, for the larger operations, increases in capital costs are incurred too. Such extra costs are accounted for in the analysis. The base case for comparison is the situation where the performance of the HF current herd is maintained at current levels over the 30 year period of the benefit-cost analysis. The possibility that reproduction performance of the HF herd continues to decline steadily over the planning period, such that herd replacement rates reach 30 per cent from the current 24 per cent per year, was a further scenario investigated, but there was only a marginal effect on the results.

---

<sup>2</sup> The results are not highly sensitive to the distribution of farms that is assumed.

The present value of the net benefits of increasing the proportion of the state herd that is HFJ crossbred cows was estimated. A discount rate was used to adjust the value of future net benefits to its equivalent present value equivalent. The discount rate is an adjustment made to net benefits to be received in the future for the different value people might attach to net benefits to be received in the future according to their rate of preference for benefits received sooner rather than later. An indicator of people's rate of time preference is the rate they are willing to accept to defer consumption now in exchange for investing now, e.g. the rate government bonds have to offer to entice people to lend to government, around 4% real.

Another explanation as to why a net benefit received earlier is worth more than one received later, is that a benefit received earlier can be reinvested to grow to a larger sum later. Thus a future sum has an equivalent present value. In this context, the adjustment factor is called the opportunity cost. This means that the net benefits received from capital put into one investment project are adjusted by the potential earning rate of capital if it was put into another project, called the opportunity cost, to see if the investment project in question promises to provide a better return than the alternative. An indicator of opportunity cost is the common earning rate of investments in the economy. e.g. 5-8% real.

In this analysis, the value of net benefits to the recipients, expected to be received in the future, are adjusted to their equivalent present value at an annual rate time preference of 4% real.

For the given set of assumptions about the net benefits some dairy farm systems might achieve from changing from a HF system to a HFJ system, and for the adoption of this change throughout a portion of all the herds in Victoria, the present value of the net benefits over thirty years is expressed in terms of the equivalent in current dollars after being adjusted by 4% per year. The interpretation in this situation is as follows:

Ignoring research and development costs, if the present value of future net benefits from a change, discounted at 4% real per annum, is positive, it means the farmers who have made the change and society is better off by the present value dollar sum when compared with the situation where the change from HF to HFJ cows was not made.

Considering research and development costs, suppose the only extra costs above the net benefits estimated at farm level were research and development costs, and the information from the research and development investment contributed some

proportion of the reasons the decision was made to make the change. The interpretation of results in this situation is:

the present value of net benefits, discounted at say a higher discount rate to allow for the high risk associated with investment in research, and adjusted for the proportion that is directly attributable to information that came out of the research and development investment, indicates how much could be invested, in present value terms, in such research and development.

## **Results**

In Figures 6 and 7 below is shown the estimated present value of net benefits at 4% real discount rate from a range of adoption levels of HFJ cows in the Victorian dairy industry over 30 years, with full adoption achieved by years 15 and by 10 years respectively.

Figure 6: Present Value of Benefits at 4% discount rate, 15 years to full adoption, 30 years time horizon

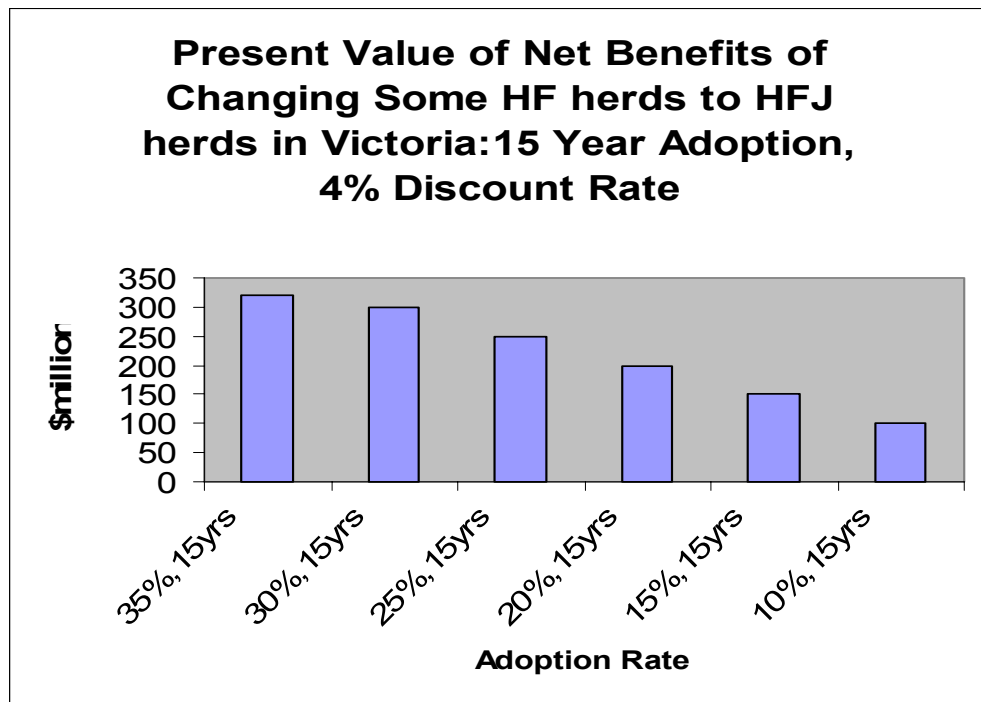
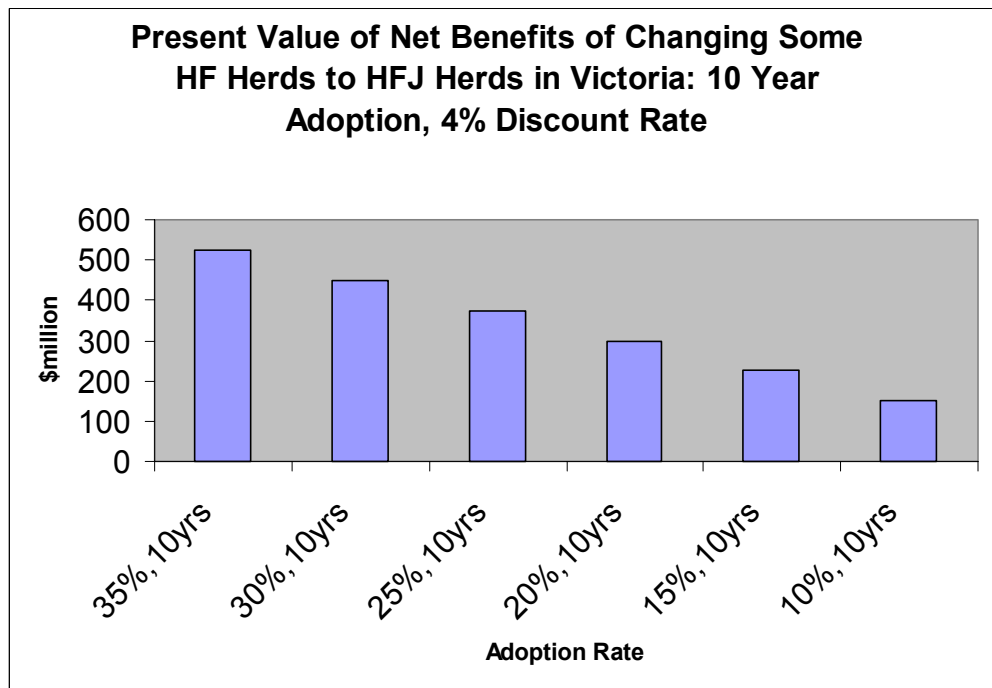


Figure 7: Present Value of Benefits at 4% discount rate, 10 years to full adoption, 30 years time horizon



If 20 per cent of HF herds changed to HFJ herds by year 15, this would bring the total proportion of the Victorian dairy herd to 30 per cent HFJ cows. The present value of net benefits of 20% of HF herds changing to HFJ herds, before the research and development investment that would be required, would be \$200m (annuity \$11.6m for 30 years). If this occurred over 10 years instead of 15, the benefits are \$300 (annuity \$17.4m for 30 years). The benefits from more rapid adoption are indicated. If the innovation makes sense, say, predominantly for the medium to small sized dairy operations, the present value of net benefits before research and development expenditures for the 20%, 15 year scenario comes to \$185m (annuity \$10.7m for 30 years).

For the case where there was a 3% advantage in FCE for HFJ cows over HF cows, and an annual profit advantage of \$18,000 over the 230 cow HF herd, then the following net benefits would apply. At 20% adoption by year 15, benefits are \$307m (annuity \$18m) at 4% discount rate, and \$461m (annuity \$27m) if 20% of herds adopted the change over 10 years.

In Figure 8 and 9 is shown the same range of net benefits from conversion of a proportion of the Victorian HF dairy herd to HFJ herds, discounted at a high, research- risk-adjusted, discount rate of 25% real, for 15 and 10 years adoption periods respectively. If 20% of herds changed to HFJ herds over 15 years, the benefits are \$23m (annuity \$1.3m for 30 years). If the same adoption occurred over 10 years, benefits are \$33m (annuity \$1.9m over 30 years). At the higher research discount rate and with a 3% advantage for HFJ cows over HF cows in FCE, at 20% adoption over 15 years, the benefits are \$35m (annuity \$2m). Over 10 years the benefits are \$52m (annuity \$3m).

These estimates of the size of expected benefits are appropriate to be used in assessing the merit of investing in research and development into crossbred dairying because they are discounted at the high rates of return required for risky investments, such as agricultural research.

Figure 8: Present Value of Benefits at 25% Research discount rate, 15 years to full adoption, 30 years time horizon

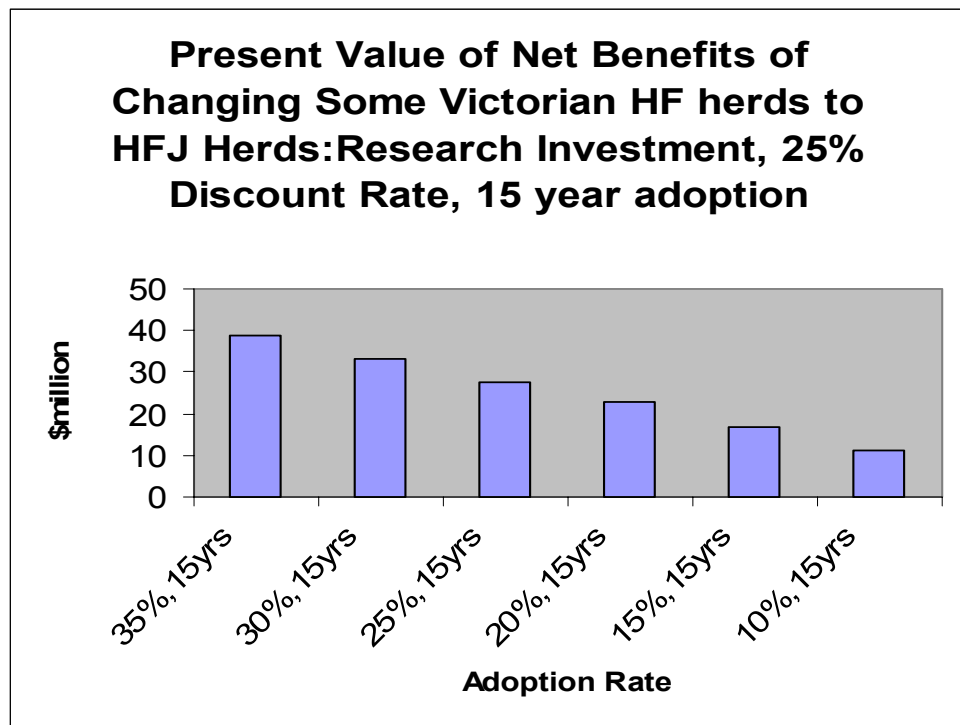
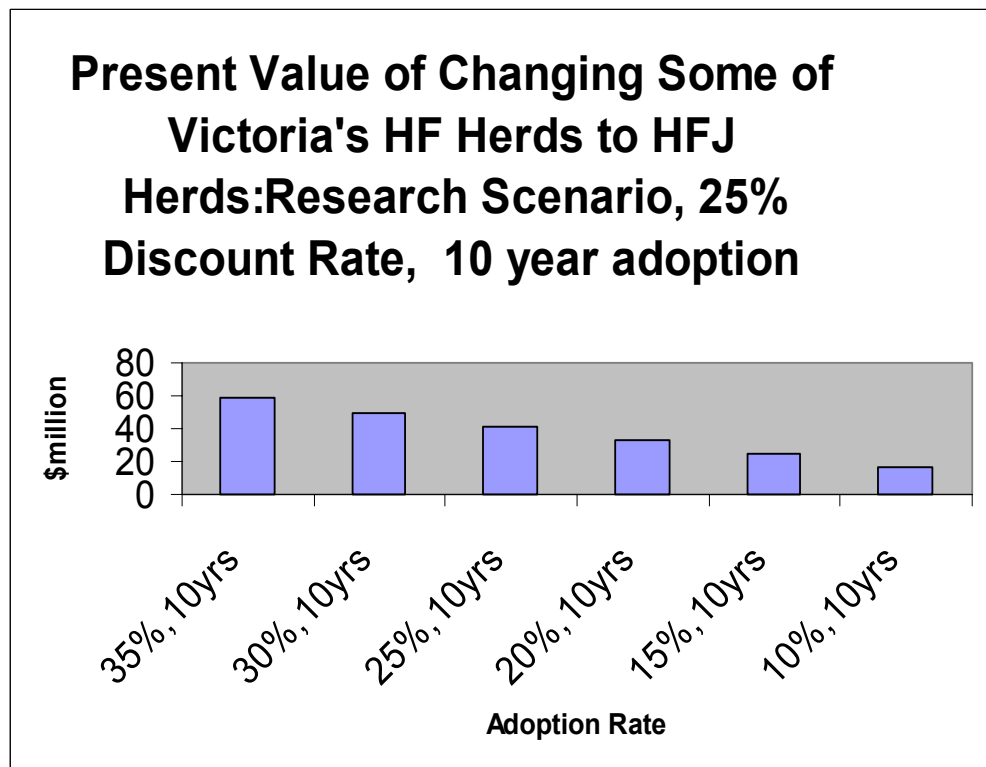


Figure 9: Present Value of Benefits at 25% Research discount rate, 10 years to full adoption, 30 years time horizon



For the scenario where 20 per cent of HF herds change to HFJ herds over 15 years, at the high required rate of return (25 % discount rate) for research investment, and with information from the R&D directly responsible for say 50% of the decision to adopt the change, then the amount that could justifiably be invested in research and development would be \$11.5m (\$17.5m. if 3% FCE advantage is expected to exist).

#### 4. Conclusion

It is likely that in some of the dairy farm systems in Victoria there could be some productivity and profit gains from a change from using HF dairy cows to using HFJ dairy cows.

Net benefits from such a change come from changed proportions and quantities of milk solids produced in the system for a given energy supply, and reduced herd depreciation and herd replacement costs, resulting in additional operating profit. The detailed applicability, or otherwise, of such a change has to be worked out on a farm case by case basis.

It is possible that the types of net benefits identified from crossbred dairying would have a higher probability of being realized if, in the future, HFJ cows are produced that are below the current liveweight, which is around 90% of the liveweight of HF cows.

It is possible the major effect of a change from a HF to a HFJ dairy system would lie in the associated system changes that may follow. Some of these changes will result in monetary net benefits, as well as some non-monetary gains. While the net gains from a change to HFJ dairying can only be identified on a farm system by system basis, if improved reproduction performance resulted in a changed system, this could in turn make it possible to change from a multiple calving to single seasonal calving system. Or, a change in the utilization or balance of feed supplies - pasture and bought in - may become possible.

To substantiate the types of conclusions indicated in the analysis of the performance of a HF dairy farm system that was converted to a HFJ dairy system, more information about the reproduction, fat and protein performance and management, including grazing performance, of various crosses of HFJ cattle in particular types of farm systems is needed. The development of an adequate and reliable supply of male and female dairy cattle with the required genetic make-up to sustain an increased

number of crossbred herds would be an important pre-requisite to potential gains from such a change being realized.

Finally: there certainly seems to be sufficient in the idea of HFJ dairying to warrant further rigorous, and thorough, investigation.

## REFERENCES

Auldist, M. and Grainger, C. (2004). A comparison of milk production, body condition, liveweight and feed intakes of pure Friesian and Friesian x Jersey cross-bred dairy cattle in Victorian pasture-based dairying systems, Final Report to GippsDairy and the DPI, April, 2004.

Armstrong, D., Ho, C., Doyle, P., and Malcolm, B. (2002). Future Dairy Farming Systems in Irrigation Regions, Final Report to DRDC, 2002.

Carrick, M., Bowman, P. and Goddard, M. (2003). Improving Herd Fertility and Survival in the Herd Using ADHIS and Herd recording Data, Final Report to the DHIF, June 2003.

Grainger, C., and Goddard, M.E. (2004). A review of the effects of dairy breed on feed conversion efficiency – an opportunity lost? Proceedings of Australian Society of Animal Production Conference, Melbourne, July 2004 (in press).

Pyman, M. (2003). Crossbreeding at the crossroads, Newsletter of Melbourne University-Gardiner Foundation Crossbreeding Project, October 2003.