Report to

Dairy Australia

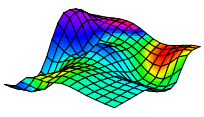
Cost Benefit Analyses

of

Selected Dairy Australia Investments

FINAL REPORT

22 November 2007



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ACKNOWLEDGMENT

Dairy Australia engaged BDA Group to undertake eight cost benefit analyses on a number of major and completed investments. Although these analyses have been completed as part of a broader assessment of the returns from Australian agricultural research and development expenditure, Dairy Australia increased the scope of the evaluation to demonstrate how benefits are generated across the many areas in which they invest.

Mr David Roche, Dairy Australia's Manager of Strategy and Planning, has overseen this assignment and his support is gratefully acknowledged. Other Dairy Australia staff kindly provided background information on specific investments and feedback on preliminary evaluations. Their contribution is also acknowledged. Despite every effort to clarify issues raised any remaining errors or omissions are the responsibility of the authors.

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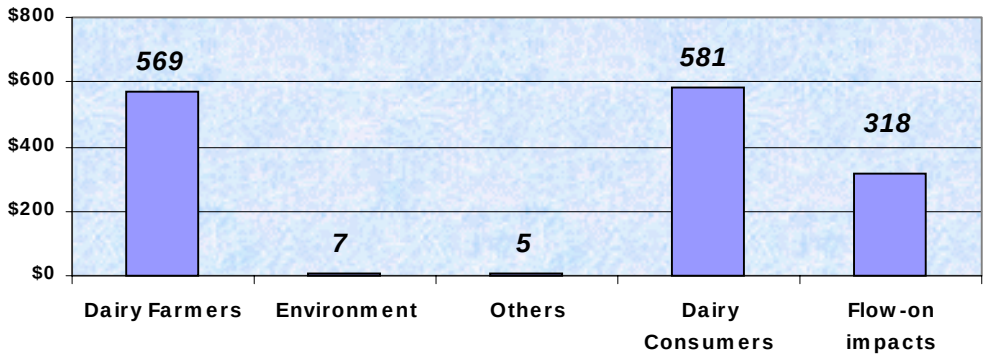
EXECUTIVE SUMMARY

Cost benefit analyses were undertaken on eight major and completed investment outcomes to demonstrate the range of returns generated on investments made by Dairy Australia and to provide a measure of the minium return achieved on Dairy Australia's investment portfolio between 2003/04 and 2005/06. Investment benefits were described as either economic (benefits captured by dairy farmers), environmental (environmental benefits captured by the broader Australian community) or social (benefits captured by other industries or Australian consumers of dairy products).

The main beneficiary from Dairy Australia's investment across the eight individual projects was estimated to be Australian dairy consumers, who benefit from lower prices for dairy products. Dairy farmers were estimated to capture an estimated $569m. Environmental benefits were found to be relatively small compared to other benefits generated. However, it should noted that the dairy industry operates in tradeable commodity markets for water, nutrients and energy and hence gains captured through savings in these commodities will deliver a direct economic impact. Flow on impacts to other Australian production activities were estimated at $318m.

Estimated Benefits from Selected Dairy Australia Investments: $ millions



For the eight individual investment projects returns were estimated for the following groups.

Levy Payers	Levy payer funds invested compared to benefits realised by dairy farmers alone. In total $15.6m of levy payer funds was invested.
All investment partners	All funds invested by Dairy Australia and partners compared to benefits realised by dairy farmers alone. In total $36.5m was invested, including $20.3m of Dairy Australia funds.
Australia	All funds invested by Dairy Australia and partners compared to benefits realised by all sectors of the Australian community.

All the eight projects evaluated were estimated to have delivered a positive return to each of the three groups considered. The range of returns generated across the eight investment projects is presented in the table below.

RANGE OF INVESTMENT RETURNS REALISED	Individual Investments	
	NPV	BCR
Returns to Levy Payers	$1m to $199m	1 to 334
Returns to all investment partners	$1m to $198m	2 to 125
Returns to Australia	$16m to $522m	4 to 206

Note: NPV is the net present value and BCR is the benefit cost ratio

Over the period 2003/04 and 2005/06 Dairy Australia invested $146m including $86m collected through the levy on dairy farmers (in present value terms and in 2007 dollars). Because the eight individual investment projects were part of Dairy Australia's total investment portfolio between 2003/04 and 2005/06 they can be used, on an aggregated basis, to derive an estimate of the minimum portfolio return. The estimated return on Dairy Australia's investment portfolio is presented below.

PORTFOLIO RETURN	Portfolio	
	NPV	BCR
Return on Levy Payer funds	$483m	6.6
Return on all DA funds	$423m	3.9
Return to Australia on all DA funds	$1,334m	10.1

Note: NPV is the net present value and BCR is the benefit cost ratio

In summary, the estimated portfolio return demonstrates that:

1. Dairy Australia has delivered a minimum return to Australian dairy farmers of $3.90 on every dollar invested between 2003/04 and 2005/06.
2. Levy payers achieve significant leverage on their funds by investing through a range of partnerships rather than "going it alone". Between 2003/04 and 2005/06 Dairy Australia has delivered a minium return to dairy farmers of $6.60 on every dollar collected from them through the farm levy.
3. Dairy Australia and investment partners have been able to generate additional benefits for the Australian community at large, estimated at $10.10 for every dollar invested.

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1 INTRODUCTION

In 2006 the Council of Rural Research and Development Corporations' Chairs (CRRDCC) announced that "to help levy payers and the government better understand the value of the investment in rural [research and development] R&D, the [Rural Research Corporations] RDC's have embarked on an ambitious plan to estimate aggregate RDC returns.[1]" To that end each RDC was asked to complete a cost benefit analysis of a number of major and completed investments that would demonstrate that a minimum positive return had been generated on their entire portfolio. Evaluation guidelines were circulated in May 2007. Dairy Australia commissioned BDA Group to undertake these evaluations.

This report has been prepared by BDA Group along the evaluation guidelines suggested by the CRRDCC and demonstrates that Dairy Australia has been able to deliver a positive return to its levy payers, its investment partners and Australia more broadly on its managed investment portfolio over the years 2003/04 to 2005/06. Eight major projects were selected for evaluation. While only two or three projects would have been sufficient to meet the CRRDCc's request, additional projects were included to illustrate the range of areas in which Dairy Australia invests as well as the different types of benefits that are realised across the Australian community.

A full breakdown of the distribution of costs and benefits across different sectors of the Australian community is provided in the following sections. Returns to different sectors include:

Returns to Levy Payers	Levy payer funds invested compared to benefits realised by dairy farmers alone.
Returns to all investment partners	All funds invested by Dairy Australia and partners compared to benefits realised by dairy farmers alone.
Returns to Australia	All funds invested by Dairy Australia and partners compared to benefits realised by all sectors of the Australian community.

This report is divided into two main sections. The first section of the report presents financial sustainability measures across the entire Dairy Australia investment portfolio. The second section provides details of the individual cost benefit analyses completed for each selected "major" project. For each project the industry outcome is discussed as well as the counterfactual, or what would have otherwise occurred in the absence of Dairy Australia funding. Triple bottom line benefits are derived and financial sustainability measures calculated.

Caution should be exercised in extrapolating the returns reported here to comment on anything other than the minimum return achieved on Dairy Australia's investment. The analysis does not demonstrate, or otherwise, that government support of R&D through matching funds is justified from a social perspective. This would, as noted by the Productivity Commission, require an evaluation of the extent that government support leads to more R&D being undertaken and whether the benefits were diffused[2].

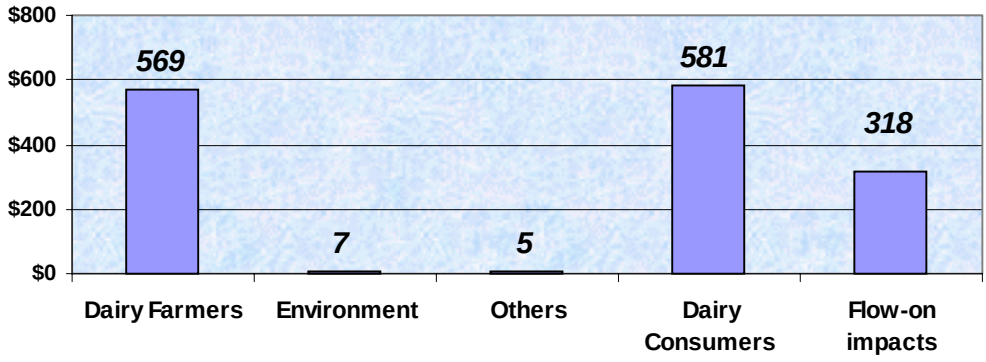
[1] CRRDCC 2006 The Benefits of Rural R&D, September 5.

[2] Productivity Commission 2007, Public Support for Science and Innovation, Research Report, Productivity Commission, Canberra.

2 VALUE OF DAIRY AUSTRALIA'S INVESTMENT PORTFOLIO

In this study eight major investment areas of Dairy Australia were examined. A cost benefit analysis was completed for each and these are discussed in more detail in the following section. The investments selected were largely undertaken between 2003/04 to 2005/06, and when combined and compared to the total Dairy Australia expenditure over this period, provide a measure of the minimum payoff achieved on all funds invested. Total benefits realised across the eight investment areas are reported in Figure 1. Benefits are expressed in present value terms – with benefits included to 2026 – and are expressed in current dollars. It was estimated that dairy consumers would realise the greatest benefits, at $581m, with dairy farmers capturing $569m. The total gain to Australia was estimated at $1.5b.

Figure 1: Estimated Benefits from Selected Dairy Australia Investments: $ millions



Between 2003/04 and 2005/06 Dairy Australia invested $162m in nominal terms or some **$146m** in present value terms (in 2007 dollars). Of this, $95m in nominal terms was contributed by dairy farmers through the dairy service levy. In present value terms (2007 dollars) the total levy value was **$86m.**

When compared to the total Dairy Australia cost it was estimated that the minimum average return to dairy farmers was **$3.9** for every dollar invested. On just the value of levies paid, the return was estimated at **$6.6** for every dollar contributed.

The average minimum return to Australia more broadly was estimated to be considerably greater than the return to dairy farmers, at **$10.1** for every dollar invested by Dairy Australia.

3 RETURNS ON SELECTED INVESTMENTS

Costs and Benefits realised from the eight investment projects evaluated in this study are summarised in Table 1 across the main beneficiaries. Levy costs include Dairy Australia expenditure of funds collected through the dairy service levy and total costs include all Dairy Australia costs and expenditure by project partners. Benefits are reported for different sectors of the Australian community. All costs and benefits are reported in 2007 dollars and in present value terms. Benefits to 2026 are included where relevant.

TABLE 1: SUMMARY OF INVESTMENT COSTS & BENEFITS: PRESENT VALUE: $M

Investment	Costs		Benefits				
	Levy	Total	Levy Payers	Environment	Others	Consumers	Flow-On
ADHIS	$0.6m	$2.1m	$200m			$22m	$120m
CDDU	$0.5m	$1.8m	$225m			$25m	$121m
Dairy Moving Forward[a]	$2.3m	$6.0m	$18m		$1m	$2m	$10m
Dairying for Tomorrow	$0.8m	$7.5m	$14m	$6m		$2m	$9m
Eco-efficiency	$0.1m	$0.5m	$9m	$1m		$1m	$5m
Lactose Utilisation	$3.4m	$10.1m	$18m		$4m	$2m	$10m
Novel Products Japan	$0.3m	$0.9m	$76m			$8m	$41m
Dairy Food of Life	$7.6m	$7.6m	$9m			$519m	$2m
TOTAL			**$569m**	**$7m**	**$5m**	**$581m**	**$318m**

Note: Others includes research partners and beef producers. (a) On the Ground

Investment projects were selected on the basis of an expectation that positive returns had been generated as well as to illustrate the major areas of activity that Diary Australia supports. Major investment projects included:

ADHIS Australian Dairy Herd Improvement Scheme – a program that delivers increased rates of genetic gain across the industry through collection, analysis and dissemination of performance data on Australian and international bulls.

CDDU Countdown Downunder – a program that provides a focus for mastitis management to assist dairy farmers reduce the costs associated with high cell counts in their herd.

Dairy Moving Forward An innovative extension program to assist dairy farmers increase business profitability through unprecedented market conditions brought about by deregulation and drought.

Dairying for Tomorrow the On the Ground component of this program sought to engage dairy farmers directly to assist the many organisations seeking improved environmental outcomes to achieve these improvements.

Eco-efficiency This program assisted Australian dairy manufacturers to identify and implement in-factory strategies that would deliver increased profitability as well as targeted environmental improvements.

Lactose Utilisation This program sought to improve lactose recovery from whey streams and in doing so to enable dairy manufacturers to increase the profitability of their lactose recovery operations.

Medium Fat Cream Cheese Export markets are highly protected and Dairy Australia is involved in protecting and improving dairy access to international markets. Japan is one of the most highly protected markets for dairy products and investment in this project has helped secure the Australian medium fat cream cheese market in Japan. Without this market product would be sold at a much discounted rate elsewhere.

Dairy Food of Life Domestic milk sales account for 50% of all milk produced. Increased demand for dairy products means more milk will be sold and that prices received by dairy farmers will increase. The DFOL campaign was a major area of investment by Dairy Australia to stimulate the Australian demand for dairy products.

In the following sections details of the cost benefit analysis completed for each major project is reported. For each project, or investment area, a brief description of the investment and the industry outcome is provided. The counterfactual, or outcome that would have otherwise occurred without Dairy Australia support is also examined. The difference between outcomes achieved with the Dairy Australia investment and the outcomes that would have been achieved anyway is used to derive an estimate of the benefits that can be attributed to the Dairy Australia investment.

Following CRRDCC guidelines, financial sustainability measures are estimated for four different time periods, extending to 20 years from now. These measures include the investment's net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR).

Because each major investment project has different time spans and distributions of costs and benefits through tine the most useful financial sustainability measure that can be used to compare investments is the benefit cost ratio. A summary of estimated benefit cost ratios is reported in the table below.

Table 2: Estimated Benefit Cost Ratio for Major Projects

Investment	Returns		
	Levy Payers	**All Investment Partners**	**Australia**
ADHIS	334	95	163
CDDU	281	125	206
Dairy Moving Forward[a]	8	3	5
Dairying for Tomorrow	18	2	4
Eco-efficiency	91	18	33
Lactose Utilisation	6	2	4
Novel Products Japan	254	85	140
Dairy Food of Life	1.2		70

(a) On the Ground

3.1 AUSTRALIAN DAIRY HERD IMPROVEMENT SCHEME

Dairy Australia has a had a long association with the Australian Dairy Herd Improvement Scheme (ADHIS). ADHIS is run as a separate entity under the Australian Dairy Farmers Federation on a not-for-profit basis. The main activity of ADHIS is the calculation and dissemination of Australian Breeding Values (ABVs) for key genetic traits. Over 30 traits have been added since its formation in 1983 as well as a number of selection indices, such as the Australian Profit Ranking and Australian Selection Index.

ADHIS maintains a national database of the performance and pedigree of Australian and International bulls (as well as some information on cows). ABVs for all traits and all animals are released three times a year to industry, and there are a number of related services that ADHIS provides on a fee basis.

ABVs provide dairy farmers with objective performance data that is used to make bull and semen selection decisions with the overall goal of increasing herd productivity and profitability. ABV information is used directly by farmers to source semen and also used as the basis for selection of elite lines from which bulls are produced and sold for use in commercial herds. Rates of genetic gain achieved in ADHIS bulls will also be achieved in commercial herds, but at a later date.

When semen is purchased using ABV data there will be a lag of two years until the performance gain is realised in a commercial herd (generation interval). ABARE estimated that in 2004/05 just over 50% of calves born were from artificially inseminated cows and that 95 % of farms breed their own replacement heifers[3]. For calves born with natural service (not artificially inseminated) there will be an additional time lag before commercial benefits are realised. Selection decisions based on ABVs would be made in seedstock herds and then time would be required for bull progeny to reach maturity. This would increase the time lag toe around two generation intervals (or around 4 years).

3.1.1 Investment Details

Dairy Australia provides core funding to ADHIS that accounts for around 60% of total expenditure. ADHIS runs its own computer facility and has in-house expertise in statistics, genetics and database management. This ensures that calculated ABVs are independent and robust and appropriate services are developed to meet industry demand.

ADHIS also has an advisory committee that includes representation from herd improvement centres, artificial breeding companies, the National Herd Improvement Association and Breed societies. Cost details are reported TABLE 3.

[3] Lubulwa, M. & Shafron, W. 2007, Australian Dairy Industry: technology and Farm Management Practices: 2004-05, ABARE Research paper 07/9, Prepared for Dairy Austria, Canberra, April.

TABLE 3: ADHIS INVESTMENT COST

Party	2003/04	2004/05	2005/06
Dairy Australia	$396k	$447k	$465k
Industry	$264k	$298k	$310k
Total	***$660k***	***$745k***	***$775k***

3.1.2 Industry Impact

The key industry impact has been an increased rate of genetic progress than would otherwise have been the case. The rate of genetic gain (or productivity increase through time) in artificially breed cows has been estimated at around 1% each year since ADHIS began in 1983[4]. Valuing this gain across commercial herds can be problematic because individual herds have different breeding objectives and hence the selection of one trait such as milk yield is unlikely to provide a robust estimate. However, since 2001 ADHIS has reported an ABV called the Australian Profit ranking which is a weighted average across a number of genetic traits. Changes in the ABV for this trait provides a more representative estimate of profit gains that have been achieved through time with genetic progress as a result of ADHIS.

The average annual increase in the reported Australian Profit ranking ABV has been estimated by Dairy Australia at $6 per cow. This is a cumulative gain through time. The counterfactual, or genetic progress that would have occurred without investment in ADHIS, has also been examined by Dairy Australia. They concluded that without ADHIS there would be limited means to identify bulls with higher genetic merit because it would be unlikely that the national progeny testing scheme would exist in terms of its coverage and level of comparison. Consequently, genetic progress in commercial herds would tend to mirror the genetic progress of imported sires. The rate of progress of imported genetic material, as measured by the Australian Profit Ranking ABV, was estimated by Dairy Australia at $2.30 per cow. The difference between the genetic gain achieved through ADHIS and on imported material ***($3.70 per cow***) represents the estimated impact of ADHIS products and services on the Australian dairy industry.

[4] ADHIS Website

3.1.3 Triple Bottom Line Benefits

Benefits are generated from Dairy Australia's ADHIS investment across two target groups. The first is for cows bred through artificial insemination and the second is cows bred through natural service. As mentioned in section 3.1.1, the rate of genetic gain across these two groups will be the same except that there will be a time lag of four years (not two years) until benefits are realised across the latter group. For the purpose of this evaluation it was assumed that cow numbers remain at 2 million across the evaluation period (2003/04 to 2025/26) and that 50% of cows are artificially inseminated each year.

Economic

The economic benefits through time from ADHIS are reported in TABLE 4. Benefits are calculated by multiplying the number of cows (either artificially breed or through natural service) by $3.70 – the average per cow benefit from having access to superior genetic material through ADHIS.

TABLE 4: ESTIMATED BENEFITS FROM ADHIS THROUGH TIME: $ MILLIONS

Year	Artificially Breed Cows	Natural Service Cows	Total
2004			
2005			
2006	$3.8		$3.8
2007	$7.7		$7.7
2008	$11.4	$3.8	$15.1
2009	$11.1	$7.7	$18.8
2010	$11.1	$11.4	$22.5
2011 onwards	$11.1	$11.1	$22.2

Social

Social gains will include consumer benefits from a more competitive dairy sector as well as flow on impacts from increased production across regional areas of Australia. It was estimated[5] that 90% of the economic benefits would be captured by dairy farmers and the remainder largely captured by Australian consumers.

Benefits to regional economies can be described in terms of flow on impacts to regional economies as a result of increased dairy production. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[6] at 54 cents of every dollar of economic benefit captured by dairy farmers.

3.1.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australia community, including dairy farmers, the dairy industry as a whole and the Australian community more broadly. In TABLE 5 below the distribution of benefits across different sectors is provided.

TABLE 5: ESTIMATED INVESTMENT BENEFITS: BY SECTOR: $MILLIONS

Year	Dairy Farmers	Australia	
		Dairy Consumers	Economic Activity
2006	$3.4	$0.4	$2.0
2007	$6.9	$0.8	$4.1
2008	$13.6	$1.5	$8.2
2009	$16.9	$1.9	$10.1
2010	$20.2	$2.2	$12.1
2011 onwards	$20.0	$2.2	$12.0

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[5] CRA and BDA Group models are discussed in the Appendix

[6] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

Financial sustainability measures derived included the net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR) on the investment made. A discount rate of 5% was used and all costs were converted to 2007 dollars using the consumer price index. The following sections present estimated measures by different segments of the Australian community.

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. Measures are reported for costs and benefits realised to date and from 5, 10 and 20 years from now.

The payoff to levy payers achieved to date from investment between 2003/04 and 2005/06 was estimated at $8.0m in present value terms or a return of $14 for every dollar invested through the farm levy. Through time the return to levy payers will increase as genetic gains achieved are sustained. The total payoff to levy payers with benefits included to 2026 was estimated at nearly $200m with an IRR of 359%.

TABLE 6: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	To date	5 years	10 years	20 years
PVB	$8.6m	$72.7m	$128.5m	$200.2m
PVC	$0.6m	$0.6m	$0.6m	$0.6m
NPV	$8.0m	$72.1m	$127.9	$199.6m
BCR	14	121	214	334
IRR	323%	359%	359%	359%

Note: PVB is the present value of benefits and PVC is the present value of costs

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with the Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested. Measures are reported for costs and benefits realised to date and from 5, 10 and 20 years from now.

The payoff dairy farmers achieved to date from investment made by all parties between 2003/04 and 2005/06 was estimated at $6.5m in present value terms or a return of $4 for every dollar invested. Through time the return to dairy farmers will increase as genetic gains achieved are sustained. The total payoff to levy payers with benefits included to 2026 was estimated at over $198m with an IRR of 184%.

TABLE 7: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date	5 years	10 years	20 years
PVB	$8.6m	$72.7m	$128.5m	$200.2m
PVC	$2.1m	$2.1m	$2.1m	$2.1m
NPV	$6.5m	$70.6m	$126.4m	$198.1m
BCR	4	35	61	95
IRR	132%	184%	184%	184%

Note: PVB is the present value of benefits and PVC is the present value of costs:

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that have been realised Australian consumers of dairy products and regional economies. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested.

TABLE 8: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date	5 years	10 years	20 years
PVB	$14.7m	$124.4m	$219.8m	$342.5m
PVC	$2.1m	$2.1m	$2.1m	$2.1m
NPV	$12.6	$122.3m	$217.7m	$340.4
BCR	7	59	105	163
IRR	204%	249%	249%	249%

Note: PVB is the present value of benefits and PVC is the present value of costs:

The payoff to Australia to date from investment made by all parties between 2003/04 and 2005/06 was estimated at $12.6m in present value terms or a return of $7 for every dollar invested. Through time the return to Australia will increase as genetic gains achieved are sustained. The total payoff to Australia with benefits included to 2026 was estimated at $340m with an IRR of 249%.

3.1.5 Conclusions and Sensitivity Analysis

The pay off to both levy payers and Australia as a whole from investment in ADHIS was estimated to be positive and substantial. Genetic improvement delivers gradual but cumulative gains through time. In the analysis undertaken here, the impact of ADHIS over a three year period was examined. Three years of genetic improvement will deliver significant gains across the industry.

A sensitivity analysis was carried out on the impact of the assumed rate of genetic gain per cow on the estimated pay off to dairy farmers on all funds invested in ADHIS. It was found that the breakeven genetic gain per cow was less than 4 cents. Given the very low breakeven genetic gain it is likely that ADHIS has delivered a positive and high return to the industry.

3.2 COUNT DOWN DOWNUNDER

Countdown Downunder (CDDU) was set up in 1998 to provide a focus for mastitis management across Australian dairy farms. The "count" in countdown refers to the number of somatic mastitis cells in raw cows' milk and is measured in thousands of cells per mL. If mastitis is effectively controlled on-farm milk supplied to processors will have a low cell count. On the other hand, "high cell counts interfere with dairy product manufacture and indicate poor quality processes on-farm"[7].

In the mid 1990's Australian processing companies developed the Herd Milk Cell Counts (HMCC) reporting system that enabled cell counts to be identified for individual farms. Milk supplies with extremely high cell counts were penalised through the pricing system while supplies with low cell counts attracted a premium. This milk pricing system provided an additional incentive for farmers to improve their mastitis control. There are also direct farm level costs associated with mastitis. The clinical cost of mastitis on farm has been estimated at nearly $170 per cow (treatment cots, discarded milk, decreased yields, mortality and culling)[8].

In 1998 the European Economic Commission passed a directive that milk or milk products made from raw milk with cell counts above 400,000 cells per mL was unsuitable for human consumption. Concerns were also raised about antibiotic residues in milk. Recognising that farm level control of mastitis was complex and, against the increasing need to reduce average cell counts across the industry, the Australian Mastitis Advisory Council established industry wide goals to be achieved by July 2001. These goals were for all milk supplies delivered to processors to be less than 400,000 cells per mL and more than 90% of supply to be less than 250,000 cells per mL.

CDDU established a national cell count statistic in 2000 (the Bulk Milk Cell Count – BMCC) which superseded processors HMCC. The BMCC statistic enabled progress towards the industry goal to be measured and complemented the broader CDDU investment up to 2004. This investment was aimed at building the capacity of farmers, the advisory sector (dairy company field staff, veterinarians, milking machine technicians, pharmaceutical and equipment suppliers and staff from government departments) and peak industry organisations to manage mastitis on dairy farms.

By 2004 considerable progress had been made towards achieving industry goals. The investment strategy from 2004 to 2009 was seen as the final step of CDDU in which skills, information and extension networks would be firmly established across the industry so that best practice mastitis could be achieved and maintained on-farm.

7 DRDC 2001, Countdown Downunder 1999-2001 Improving mastitis control on dairy farms, DRDC project report HP001

8 Dairy Australia 2005, Countdown Downunder 2001-2004 – Building industry capacity to control mastitis and manage milk quality, Project HP10804, November

3.2.1 Investment Details

Dairy Australia was the major funder of CDDU. Over the period 2004 to 2007 Dairy Australia invested just over $1m in the program with additional funds of $0.2m provided through the Regional Development programs. CDDU has been extended for an additional two years with investment of $0.7m.

Table 9: CDDU Investment Cost

Party	2004/05	2005/06	2006/07	2007/08	2008/09
Dairy Australia	$383k	$383k	$383k	$300	$300k
Industry	$63k	$63k	$63k	$50k	$50k
Total	***$446k***	***$446k***	***$446k***	***$350k***	***$350k***

While the earlier years of CDDU was focussed on bridging the gap between farmers and farm advisers so that joint action was taken to better control mastitis, the current program has encouraged farmers to regularly review their management plans and take action when required. At the conclusion of this final stage of CDDU it is envisaged that the skills and information developed under CDDU will be firmly entrenched across industry. The core components of CDDU include[9]:

(1) Refining core resources – Farm guidelines and Technotes were updated to incorporate appropriate processes that farmers can pursue to implement change.

(2) Embedding the process to achieve best practice on farms – A collaborative effort with farm advisers to package CDDU as an effective and repeatable service that is recognised by both advisers and farmers.

(3) Continuity of key elements – including the collection and analysis of cell count data from dairy companies, maintaining a positive connection with advisers, updating dairy farmers on topical information, delivery of CDDU Farmer short courses and providing independent opinion on technical issues relating to mastitis and milk quality control.

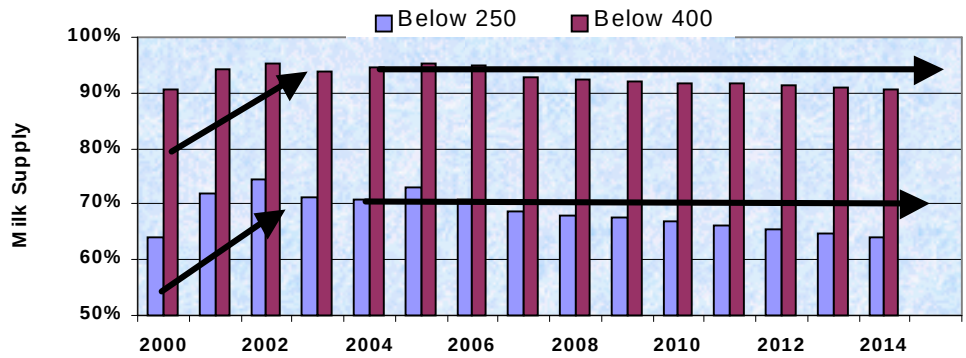
9 Details sourced form Project Brief submitted to DA on 12th November 2004. A decision was made to extend the program for a further twi years in 2007.

3.2.2 Industry Impact

As shown in FIGURE 2 there has been significant progress towards the national cell count goal between 2000 and 2004. However, the steady progress towards the national goal was reversed in 2003 and it became apparent to CDDU managers that a further reversal was likely. A number of factors contributed to the reversal of the cell count trend including severe drought conditions, high feed costs and low farm gate milk prices. To manage short term cash flows many farmers reduced expenditure on products and services required for proper mastitis control and many reduced their herd size which limited the opportunity for strategic culling.[10]

Between 2004 and 2007 the emphasis of CDDU has been on maintaining cell counts at the 2004 level, and this will continue through to the end of the CDDU program in 2009. For the purpose of this evaluation it has been assumed that the counterfactual, or "without" Dairy Australia investment scenario is that the cell count trend would continue to reverse up to 2014 at which time the National cell count would be similar to the 2000 (or pre-CDDU) level.[11] This scenario is also shown in FIGURE 2. A linear fall in national cell count was assumed and the bold arrow form 2004 depicts the case where national cell counts are maintained at the 2004 level.

FIGURE 2: PROPORTION OF NATIONAL MILK SUPPLY BELOW 250K AND 400K CELLS PER ML



3.2.3 Triple Bottom Line Benefits

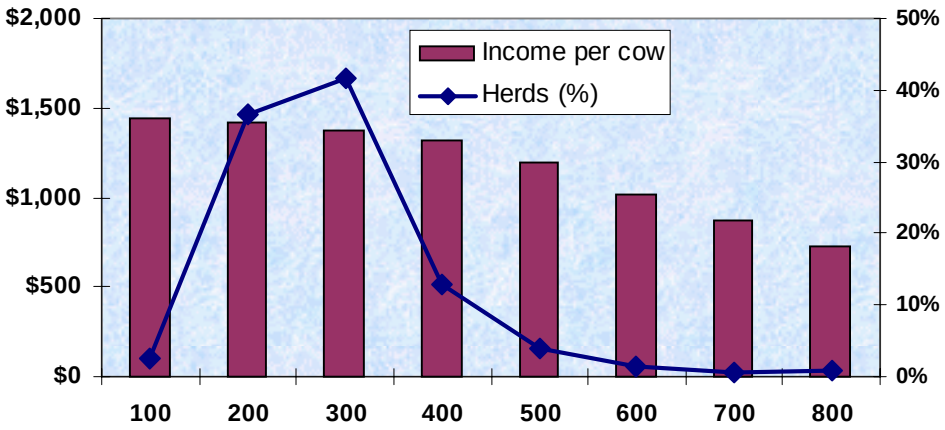
To estimate benefits from maintaining national cell counts at the 2004 level net annual income per cow was derived for different BMCC categories using the Countdown Mastitis Model. In FIGURE 3 the distribution of herds by different BMCC categories is reported along with the estimated income per cow per year for each category. Income per cow is estimated to decline as the BMCC increases, as shown in FIGURE 3. The loss of income includes lost production, milk quality penalties and mastitis control expenses. Costs will be underestimated to

[10] These factors are described in the CDDU November 2005 report.

[11] DA staff have reported that a similar trend has been observed in the New Zealand dairy industry.

some extent as no account is made for additional labour or the reduced survival, culling and replacement of infected cows[12].

FIGURE 3: ESTIMATED INCOME PER COW PER YEAR: BY BMCC CATEGORY: 2004 DOLLARS



Note: 100 refers to a BMCC of less than 100,000 cells per mL and 200 refers to a BMCC of between 100,000 and 200,000 cells per mL. Higher Categories report increments of 100,000 cells per mL.

Income figures for 2004 were converted to 2007 dollars using the consumer price index and averages were derived for three cell count groups. The estimated income per cow for herds with BMCC of less than 250,000 cells per mL was estimated at $1,560, at $1,495 for herds with a BMCC between 250,000 and 400,000 cells per mL and $1,190 for herds with a BMCC in excess of 400,000 cells per mL.

Economic

Income differentials estimated above were used to derive an average income per cow based on different national BMCC distributions. By maintaining National BMCC distributions at the 2004 level, increasing losses through time would be avoided. TABLE 10 reports annual changes in the National BMCC without CDDU and loss of income per cow. Benefits are estimated to increase slowly to a maximum of $13.3 per cow from 2014 onwards. From 2014 BMCC it was assumed that the National BMCC distribution would be held at the pre-CDDU level. At that time the total loss across all cows is estimated at $26.6m.

Although gains have been realised between 2000 and 2004 – as the average BMCC fell over this period – these gains can be attributed to the CDDU investment before 2004.

[12] Details are reported in CDDU February 2006 submission to DA by CDDU managers

TABLE 10: ESTIMATED LOSSES THROUGH TIME IF AVERAGE BMCC INCREASES.

Year	National BMCC Distribution			Cows	Income	Loss
	<250,000	250,000 - 400,000	>400,000	Million	$ / cow	$ / cow
2000	64.2%	26.5%	9.3%	2.20		
2001	71.8%	22.5%	5.7%	2.20		
2002	74.6%	20.7%	4.7%	2.10		
2003	71.3%	22.5%	6.2%	2.00		
2004	70.8%	22.8%	6.4%	2.00	$1,523	$0.0
2005	70.1%	23.2%	6.7%	2.10	$1,522	$1.3
2006	69.5%	23.5%	7.0%	2.00	$1,521	$2.7
2007	68.8%	23.9%	7.3%	2.00	$1,519	$4.0
2008	68.2%	24.3%	7.6%	2.00	$1,518	$5.3
2009	67.5%	24.7%	7.9%	2.00	$1,517	$6.7
2010	66.8%	25.0%	8.1%	2.00	$1,515	$8.0
2011	66.2%	25.4%	8.4%	2.00	$1,514	$9.3
2012	65.5%	25.8%	8.7%	2.00	$1,513	$10.6
2013	64.9%	26.1%	9.0%	2.00	$1,511	$12.0
2014	64.2%	26.5%	9.3%	2.00	$1,510	$13.3

Social

Social gains will include consumer benefits from a more competitive dairy sector as well as flow on impacts from increased production across regional areas of Australia. It was estimated[13] that 90% of the economic benefits would be captured by dairy farmers and the remainder largely captured by Australian consumers.

Benefits to regional economies can be described in terms of flow on impacts to regional economies as a result of increased dairy production. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[14] at 54 cents of every dollar of economic benefit captured by dairy farmers.

[13] CRA and BDA Group models are discussed in the Appendix

[14] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

3.2.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australia community, including dairy farmers, the dairy industry as a whole and the Australian community more broadly. In TABLE 11 below the distribution of benefits across different sectors is provided.

TABLE 11: ESTIMATED INVESTMENT BENEFITS: BY SECTOR: $MILLIONS

Year	Dairy Farmers	Australia	
		Dairy Consumers	Economic Activity
2005	$2.5	$0.3	$1.4
2006	$4.8	$0.5	$2.6
2007	$7.2	$0.8	$3.9
2008	$9.6	$1.1	$5.2
2009	$12.0	$1.3	$6.5
2010	$14.4	$1.6	$7.8
2011	$16.8	$1.9	$9.1
2012	$19.2	$2.1	$10.3
2013	$21.5	$2.4	$11.6
2014 onwards	$23.9	$2.7	$12.9

Financial sustainability measures derived included the net present value (NPV) and benefit cost ratio (BCR). The annualised internal rate of return (IRR) on the investment made was not derived because there was a net benefit in year one. A discount rate of 5% was used and all costs were converted to 2007 dollars using the consumer price index. The following sections present estimated measures by different segments of the Australian community.

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. Measures are reported for costs and benefits realised to date and from 5, 10 and 20 years from now.

The payoff to levy payers achieved to date from investment between 2003/04 and 2006/07 was estimated at $12.5m in present value terms or a return of $26 for every dollar invested through the farm levy. Through time

the return to levy payers will increase as the average National BMCC is maintained at 2004 levels. The total payoff to levy payers with benefits included to 2026 was estimated at $225m with a BCR of 281

TABLE 12: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	To date	5 years	10 years	20 years
PVB	$13m	$66m	$147m	$225m
PVC	$0.5m	$0.8m	$0.8m	$0.8m
NPV	$12.5m	$65.2m	$146.2m	$224.2m
BCR	26	83	184	281

Note: PVB is the present value of benefits and PVC is the present value of costs

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with the Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested. As all benefits have been realised to date, financial sustainability measures are only reported for one evaluation period.

The payoff to levy payers achieved on all funds invested to date between 2003/04 and 2006/07 was estimated at $11.8m in present value terms or a return of $11 for every dollar invested through the farm levy. Through time the return to levy payers will increase as the average National BMCC is maintained at 2004 levels. The total payoff to levy payers with benefits included to 2026 was estimated at $225m with a BCR of 129.

TABLE 13: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date	5 years	10 years	20 years
PVB	$13m	$66m	$147m	$225m
PVC	$1.2m	$1.8m	$1.8m	$1.8m
NPV	$11.8m	$64.2m	$145.2m	$223.2m
BCR	11	37	82	125

Note: PVB is the present value of benefits and PVC is the present value of costs:

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that have been realised Australian consumers of dairy products and regional economies. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested.

TABLE 14: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date	5 years	10 years	20 years
PVB	$21m	$109m	$242m	$371m
PVC	$1.2m	$1.8m	$1.8m	$1.8m
NPV	$19.8m	$107.2m	$240.2m	$369.2m
BCR	18	60	134	206

Note: PVB is the present value of benefits and PVC is the present value of costs:

The payoff to Australia to date from investment made by all parties between 2003/04 and 2005/06 was estimated at $19.8m in present value terms or a return of $18 for every dollar invested. The total payoff to Australia with benefits included to 2026 was estimated at $371m or a return of $206 for every dollar invested.

3.2.5 Conclusions and Sensitivity Analysis

Both the pay off to levy payers and Australia more broadly was found to be both positive and large. Even the modest gain achieved to date has delivered a positive return on funds invested.

It was recognised in this evaluation that the goal of achieving a further reduction in the National BMCC would be difficult given the severe pressures facing the industry over the past few years. Nonetheless, success has been achieved in holding the National BMCC to at least that recorded in 2004. If investment to 2009 can enable a long term stabilisation in the National BMCC to be achieved then substantial returns will be made into the future.

The main driver of pay off will be the extent to which further falls in the National BMCC can be prevented. In the analysis here it was assumed that without the CDDU investment the National BMCC would fall back to the 2000 level (pre-CDDU) by 2014. To test the sensitivity of pay off to this assumption financial sustainability measures were estimated under a slower rate of fall in the National BMCC. It was assumed that, in the absence of Dairy

Australia support that the National BMCC would fall back to the 2000 level after 20 years. Measures are reported in the Table below.

TABLE 15: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS: UNDER A 20 YEAR LAG

Measure	To date	5 years	10 years	20 years
PVB	$11m	$54m	$80m	$133m
PVC	$1.2m	$1.8m	$1.8m	$1.8m
NPV	$9.8m	$52.2m	$78.2m	$131.2m
BCR	9	30	44	74

Note: PVB is the present value of benefits and PVC is the present value of costs:

Even if it were to take a much longer period of time for the National BMCC to fall back to 2000 levels the payoff on Dairy Australia's investment would still be positive and substantial. This suggests that even modest gains in improving the average BMCC would deliver a good return on funds invested.

3.3 DAIRY MOVING FORWARD

Dairy Moving Forward (DMF) was developed by Dairy Australia and other dairy industry stakeholders to provide a better method that farmers could use to access available information on ways to increase the productivity and profitability of their dairy operations. In essence, DMF provided a more collaborative, structured and targeted extension service to dairy farmers that involved more than 50 participating industry groups.

In 1999[15] the Australian Dairy Farmers Federation (ADFF) recommended that farmers needed to be more aware, confident and responsive to the market environment they were in and the range of investment choices they faced to maximise their wealth in the future. The backdrop to this recommendation was the change in industry regulations in 2000 where farmers would no longer operate in a regulated market environment and hence there was likely to be considerable pressure for structural adjustment across the industry.

Dairy Australia responded to ADFF's recommendation in the development of their 2004-2009 strategic plan by developing strategies to increase farm productivity growth by 2% a year. Given the severe drought conditions of 2002/03 and adjustment pressures from deregulation, Dairy Australia realised that existing extension programs across the industry needed to[16]:

- better engage individual farm families rather than being delivered at a broader industry level;
- be fast tracked to provide the greatest opportunities for farmers to increase their cash flows;
- deliver results in the short term;
- be built on genuine partnerships across the industry[17]; and
- take account of major regional differences and influences.

DMF demonstrated how specific farm level issues could be successfully addressed through an improved extension framework. This framework was based on collaborative action across the industry and has provided a platform upon which future extension programs have been, and will be, designed and delivered. The *Feed Fibre Future* initiative is one such program – aimed at a specific short term industry need.

15 Australian Dairy Farmers Federation 1999, Taking Responsibility for the future, Advancing Dairy Australia , June.

16 Malcolm, B. & Paine, M. 2005, A Social Benefit Cost Analysis of Dairy Moving Forward, A report prepared fro Dairy Australia, Faculty of Land & Food Resources, University of Melbourne, December.

17 In the DMF Final Report 2006 DA reported that the required extension effort was so large that it would require resources beyond the capacity of any single organisation and further, given the industry stress of late 2003 any single organisation that took "centre stage" would have limited effectiveness.

3.3.1 Investment Details

The DMF program commenced in December 2003 and finished in December 2006. Total program costs are reported in TABLE 16.

TABLE 16: DAIRY MOVING FORWARD INVESTMENT:$'000

Party	2004	2005	2006
Dairy Australia	$500k	$3,550k	$825k
Industry Partners	$130k	$832k	$566k
Total	***$630k***	***$4,382k***	***$1,391k***

DMF investment involved three major components with on-farm change the identifiable end point. These components included:

(1) ***Clearer realities*** – survey of dairy farmers, regional dairy farmer forums, workshops with regional industry leaders and farm advisors and preparation of a situation and outlook report on the industry to identify and present details of the main issues confronting the industry. A network of regional service delivery partners was also established.

(2) ***Taking Stock*** – whole farm planning tool (covering a range of financial, herd, feed, management systems, and social issues) was developed for delivery by trained advisors (over 180) to individual dairy farmers on a one to one basis. Advisors included independent consultants, dairy company staff, rural counsellors and government extension officers. The one to one sessions were provided free to farmers with Dairy Australia and partners providing the funding. This component of DMF enabled farmers to be engaged individually, with the aim of assisting them understand their current position and to develop action plans for future change.

(3) ***Taking Action*** – this component focussed on assisting farmers act on their developed action plans. This involved development and maintenance of one on one advisory services, creation of regional based farmer groups and improved access to existing resources (such as better "sign posting" of available information or repackaging or redevelopment of material where necessary).

3.3.2 Industry Impact

Dairy Australia [17] has reported that 2,500 farmers have participated in a DMF event since its inception. Of these, 1,724 dairy farming families around Australia have completed a *Taking Stock* session with their chosen advisor – a participation rate of around 19% of all dairy farms. A Quantum Market Research report commissioned by Dairy Australia in 2005 found that 60% of farm families completing the Taking Stock session had implemented their developed action plan. Pasture production was the main area where changes were reported, followed by finance and debt servicing and issues around supplementary feeding.

The counterfactual, or without Dairy Australia, investment scenario can be considered in terms of the time period over which changes would have been made anyway. Malcolm & Paine (2005)[16] suggest that a three year period might be considered. That is, without Dairy Australia investment the changes made under DMF would have occurred anyway after a three year lag. Although a three year lag was assumed in this study, it is recognised that a longer lag might be more appropriate given that DMF was a fundamental shift in how extension services are delivered to farmers and that the market conditions prevailing over the past few years have been unprecedented.

In 2007, Dairy Australia with support from the Federal government and industry partners developed and implemented a program called *Feed-Fibre-Future (FFF)*. This program utilised the collaborative extension framework developed under DMF and was designed to address industry concerns regarding fibre shortage (and high feed costs[18]) over 2007 as a result of the drought and low water allocations. While actions taken under DMF, might have had some relevance to the conditions that prevailed in 2007 it is unknown what proportion of farmers accessed FFF as well as DMF. To ensure that benefits were not double counted in this evaluation it was assumed that DMF impacts were in 2004/05 and 2005/06 and that FFF delivered impacts in 2006/07.

Investment made in FFF was $400k by the Federal government, $206k by Dairy Australia and $416k across industry partners. FFF provided one on one advisory services to farmers regarding their winter feed gap and assisted farmers develop action plans to increase or extend their available feed. Implemented actions by farmers mainly revolved around increasing or extending available feed and sourcing capital through sales of stock or other farm capital (such as water) rather than increasing farm debt. Over 200 farmers participated in the one on one services provided by advisors with a total of 3,020 farms (2,675 dairy and 345 beef) gaining access to FFF material through one of the trained 120 service providers[19].

18 ABARE Australian dairy survey 2007 reported that average feed costs per farm increased from $94,190 in 2005-06 to $143,100 in 2006-07.

19 Results form a survey of FFF service providers indicated that each adviser had used FFF material across, on average, 22 dairy farms and 3 beef farms.

Benefits delivered through the FFF were assumed to be for one year only as it was tailored specifically for circumstances facing farmers in 2007 and was an extension of DMF for that year.

3.3.3 Triple Bottom Line Benefits

The DMF and FFF program has not been evaluated to date, although a number of case studies have been prepared for each as well as a broad summary of individual farm action plans. These case studies and action plans, as well as survey feedback from service providers were used to derive estimated triple bottom line benefits.

Economic

The main benefit from the DMF and FFF programs will be economic as they directly targeted the profitability of dairy (and to lesser extent beef) operations.

For DMF, action plans prepared by farmers were collated (on a confidential basis) by Dairy Australia. The most common actions involved some refinancing of existing loans or generation of cash flow through sale of capital items (including livestock) so that feed resources could be extended (and milk yield and quality maintained). Feed strategies included better management of pasture consumption through time so that supplementary feed costs could be reduced or milk returns increased. While feed savings of 50% have been reported in some instances, an average 10% reduction in feed costs was assumed as an indicative benefit for those farmers implementing DMF action plans. In 2004/05 and 2005/06 the average fodder cost per farm was estimated by ABARE at $77,219 and $94,190 respectively [18]. Assuming an implementation cost of $3,000[20], the net benefit per farm was estimated at around $4,700 in 2004/05 and $6,500 in 2005/06. Across those farms implementing action plans (1,000) the total net industry gain is calculated at $4.7m in 2003/04 and $6.5m in 2005/06.

Benefits from FFF were derived from advisor surveys carried out by FFF facilitators. The distribution of average net benefits realised by advisors' clients is reported in Figure 4 for dairy and beef farms. Although the median net benefit was less than $3,000 per farm (for both dairy and beef), around 20% of farmers have been able to realise net benefits of $10,000 or more. Based on this distribution the average net benefit per farm was estimated at $4,700 for dairy farmers and $3,600 for beef producers. This translates to a total gain for the dairy farmers participating in FFF of $12.5m and $1.3m for beef producers.

[20] This cost was derived from BDA Group's 2000 evaluation of DRDC outcomes, updated to 2007. The 10% cost saving was also deemed in that study to be indicative of the extent to which gains can be made, on average, from pasture extension programs.

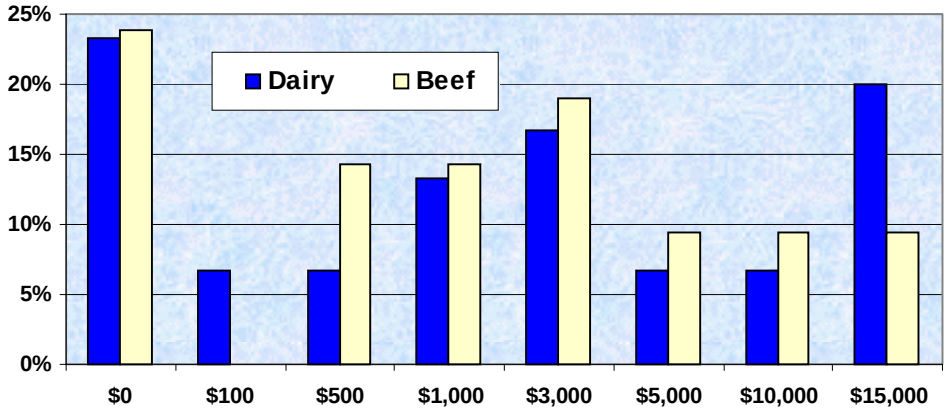
An additional qualitative survey of service providers was also undertaken to test the robustness of the net benefits estimated above. Five advisors were asked to detail changes made by two of their clients. Their feedback demonstrated how different farmers have realised net benefits, and included:

- $7,980 realised from extra milk production, premium on increased milk protein content and lower feed cost. This was achieved through drying off 20 cows and agisting on another property and changing the feed ration.

- $13,200 realised from increased milk returns ($21,600) as a result of increased fodder purchases ($8,400). Refinancing options were limited and there was little scope to increase their overdraft. A decision was made to cull 15 marginal value cows (that were not pregnant, were low producers or had high cell counts) and use the funds to retire part of their short term debt and use the remainder to purchase fodder.

- $16,000 realised from increased milk yields per cow, less penalties and increased butter fat. Main change was addition of effective fibre into the feed ration at a cost of around 30c per cow per day.

Figure 4: Distribution of Average Net Benefit per Farm from FFF



Social

Social gains will include benefits to beef producers, consumer benefits from a more competitive dairy sector as well as flow on impacts from increased production across regional areas of Australia. It was estimated[21] that 90% of the economic benefits would be captured by dairy farmers and the remainder largely captured by Australian consumers.

[21] CRA and BDA Group models are discussed in the Appendix

Social benefits can also be described in terms of flow on impacts to regional economies as a result of increased dairy production. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[22] at 54 cents of every dollar of economic benefit captured by dairy farmers.

Social gains also include the continued development and support of research, development and extension (RDE) services across Australia. While no attempt has been made here to quantify these gains it is clear that the Dairy Australia investment will lead to increased effectiveness of RD&E services in the future.

This work has also contributed to Dairy Australia's stated goal of developing industry human capacity to respond to change and complexity.

3.3.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australia community, including dairy farmers, the dairy industry as a whole and the Australian community more broadly. In TABLE 16 below the distribution of benefits across different sectors is provided.

TABLE 17: ESTIMATED INVESTMENT BENEFITS: BY SECTOR

Year	Dairy Farmers	Australia		
		Beef Producers	Dairy Consumers	Economic Activity
2005	$4.2m		$0.5m	$2.3m
2006	$5.9m		$0.7m	$3.2m
2007	$11.3m	$1.3m	$1.3m	$6.1m

Note: Dairy farmers capture 90% of the reported economic benefits.

[22] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

Financial sustainability measures derived included the net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR) on the investment made. A discount rate of 5% was used and all dollar values were converted to 2007 dollars using the consumer price index. The following sections present estimated measures by different segments of the Australian community.

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. As all benefits have been realised to date, financial sustainability measures are only reported for one evaluation period.

The payoff to levy payers was estimated at $15.7m in present value terms or a return of $8 for every dollar invested through the farm levy. The high IRR reflects the short time period over which benefits have been realised.

TABLE 18: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	To date
PVB	$18m
PVC	$2.3m
NPV	$15.7m
BCR	8
IRR	1,454%

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs and benefits were converted to 2007 dollars using the consumer price index

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with the Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested. As all benefits have been realised to date, financial sustainability measures are only reported for one evaluation period.

The payoff to dairy farmers on the total investment was estimated at $12m in present value terms or a return of $3 for every dollar invested by all partners.

TABLE 19: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date
PVB	$18m
PVC	$6m
NPV	$12m
BCR	3
IRR	231%

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs and benefits were converted to 2007 dollars using the consumer price index

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that have been realised by dairy farmers as well as beef producers, Australian consumers of dairy products and regional economies. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested. As all benefits have been realised to date, financial sustainability measures are only reported for one evaluation period.

TABLE 20: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date
PVB	$31m
PVC	$6m
NPV	$25m
BCR	5
IRR	559%

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs and benefits were converted to 2007 dollars using the consumer price index

The payoff to Australia as a whole on the total investment was estimated at $25m in present value terms or a return of $5 for every dollar invested by all partners.

3.3.5 Conclusions and Sensitivity Analysis

Investment made by Dairy Australia through the Dairy Moving forward and Feed Fibre Future initiatives was estimated to have delivered a positive return to both levy payers and Australia more broadly. The majority of benefits are expected to be realised by dairy farmers themselves, however substantial spillover benefits were estimated to accrue to the Australian community (excluding dairy farmers) more broadly.

Two key assumptions have been made in the analysis. The first the assumption that benefits would only be realised for one year was deemed to be very conservative and no sensitivity analysis was undertaken on this assumption. The second key assumption was the estimated average farm level benefit that was achieved by farmers involved with the program. The investment made by dairy farmers through the levy was estimated to break-even with a reduction in feed costs of only 1%. The conclusion that a positive return was made on the Dairy Australia investment was not found to be overly sensitive to the feed cost saving assumed in this analysis.

3.4 DAIRYING FOR TOMORROW

Natural resource management has a high priority across governments, especially in relation to agricultural operations. In recognition of the potential impact that agriculture in Australia has on water quality, resource use and biodiversity both State and Federal governments have encouraged and financially supported the development and implementation of industry focussed environmental management systems (EMS).

Dairying for Tomorrow On the Ground (DfT) was the dairy industry's response to the federal governments request to develop suitable EMS packages for the dairy industry. The primary aim of DfT On the Ground "was to boost the development of farmer capacity in natural resource management and to develop a set of processes to deal with natural resource management issues common to dairy farmers across the country"[23].

Dairy farmers, both individually and through their various associations, have shown a commitment to managing environmental impacts associated with dairying. This is evidenced by the high participation rate of dairy farmers in natural resource management groups and active involvement in many state and federal based initiatives such as Landcare. However, to get desired behavioural changes on farm industry participants require knowledge of appropriate farm level strategies that can be implemented individually or in collaboration with neighbouring land owners. Further, as implementation of an EMS typically involves some cost to farmers, it was appreciated that strategies that delivered productivity gains to farmers as well as positive environmental outcomes would have a greater chance of being adopted.

The successful legacy of the DfT On the Ground program has been to equip dairy farmers with an on-going capability to identify strategies that contribute towards environmental improvement across different catchments. This has increased the effectiveness of EMS initiatives being developed and delivered across the industry by the many different groups that work closely with farmers and the broader community.

3.4.1 Investment Details

DfT On the Ground was coordinated by Dairy Australia and involved significant collaboration with industry and community groups. The Department of Agriculture, Forestry and Fisheries (DAFF) provided seed funding to the project and also to similar projects undertaken in other rural industries. The project commenced in 2001 and concluded in 2007 and had an operational budget of $7.8m. Apart from Dairy Australia and DAFF funds $2 m was contributed by NRM agencies, Natural Heritage Trust and the National Landcare Programmes; organisational stakeholders such as state agencies , milk companies (and cooperatives) and farm service

[23] Dairy Australia 2007, Pathways to Industry EMS Dairying or Tomorrow: On the Ground Final Report

businesses contributed $2M; and there was $1.2m contributed by those farmers implementing EMS initiatives on-farm.

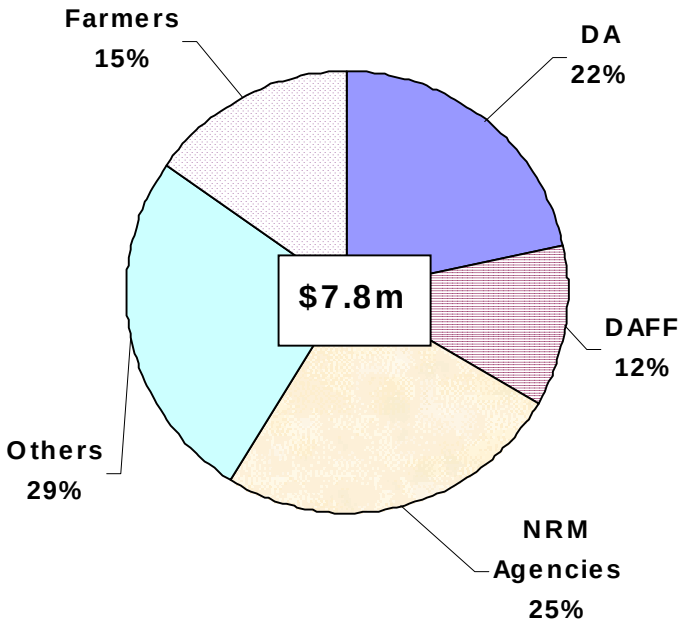


FIGURE 5: BREAKDOWN OF FUNDS CONTRIBUTED BY DIFFERENT PARTNERS

DfT On the Ground had three key components:

1. DairySAT – a farm based self assessment tool that farmers could use to assess the environmental risks associated with their own operations, to identify and prioritise issues and develop appropriate action plans.

2. Piloting BizLINK in three different regions[24]; and

3. Better PRAC – development, evaluation and implementation of tools and processes for achieving targeted change identified through farm level action plans.

The main delivery mechanism for DfT On the Ground has been the promotion and uptake of Dairy SAT through workshops and the development of an industry endorsed national learning framework and demonstration of BetterPRAC initiatives through regional pilots and promotion by DfT coordinators.

[24] It was found that integrating NRM into existing farm business planning packages may be inappropriate as it only focuses on farm operations when economic gains are being sought rather than enabling environmental outcomes to be the initial focus.

3.4.2 Industry Impact

By July 2007 1,400 farmers had completed DairySAT and of these an estimated 80% had undertaken or committed to an action plan for on-farm change[23]. While the changes made have varied across different regions and farm groups, changes have been made in three broad areas, effluent and nutrient management, water use and irrigation management and biodiversity conservation. In most cases economic and environmental outcomes have been achieved across these three areas and in some cases farmers have made changes, at their own expense, without any commensurate increase in farm income.

For the purpose of this evaluation it was assumed that there has been broad gains in water quality and biodiversity and by targeting these gains farmers have either reduced the volume of nutrients applied or achieved savings in water volumes used to irrigate pastures or made available for stock. Each of these impacts is discussed below.

(1) Water Quality and Biodiversity

Water quality impacts have been achieved through better management of dairy shed and feedpad effluent, rehabilitation of riparian lands and limiting stock movement into waterways. This has been carried out on individual properties as well as across adjoining properties that share common waterways. Under GipRip it has been estimated that 37.5 km of Gippsland's streams and rivers have been improved[25]. Over 500 farmers have participated in the GipRIP initiative. Assuming a similar response across farmers completing DairySAT (1,400) Australia wide it is likely that some 105 kms of riparian land has been improved under the DfT project.

While rehabilitating riparian land will increase biodiversity as stream rehabilitation involves management of buffer areas around waterways, there has also been protection of areas of remnant vegetation including bush corridors of land through adjoining properties, and replacement of pasture areas with native vegetation (such as protection of drainage lines and use of shelter belts). This area has been conservatively estimated at around 1 ha on average per farm where action plans have been acted upon, or some 1,120 ha in total[26].

(2) Nutrient management

25 The GipRIP Effect, Report Number 4

26 There is little information on total areas where biodiversity gains have been made. However, use of a 30 metre buffer strip would contribute around 25 ha to the total with the rest largely accounted for by the small number of farmers (groups) that have protected large areas of land – such as Jill, Ian and Amy Williams from Parawa SA who have, collectively, protected 65 ha of remnant vegetation.

Nutrient management changes have centered around better management of effluent and nutrient budgeting. Application of fertiliser can have an impact on nutrients entering waterways. Application rates can be reduced through better use of dairy effluent[27] and better matching of fertiliser applications to the nutrient requirement of growing pasture.

Improved effluent management, better matching of applied nutrients with plant requirements and nutrient budgeting has enabled pasture production to be maintained (or even increased) under reduced volumes of applied fertiliser. For the purpose of this evaluation it was assumed that half of those farmers implementing EMS action plans would realise a 25% saving[28] on their fertiliser cost each year.

Surface or overland flow is the main pathway by which nutrients can enter waterways. Average export rates of phosphorus and nitrogen have been reported at around 2 kg per ha and 10 kg per ha respectively[29]. Further, nutrient management, such as more careful matching of applied nutrients to plant requirements[30] and better effluent management (including greater capture and recycling), is likely to reduce nutrient run off. Successful nutrient management will not prevent all nutrient run off as there will tend to be a "baseline " component as a result of nutrients in soil, plant material and dung[8]. A reduction of 50% was assumed in this report.

The average area utilised by dairy cows per farm is 112 ha[31]. Reduced nutrient run off of 1 kg per ha (of phosphorus[32]) would save, on average per farm, 112 kg entering waterways. Across 560 farms this would total 63 tonnes annually.

(3) Water Management & Use

The final impact considered is water savings achieved from changes that for example, reduces leakage from existing storage and delivery infrastructure, prevents water logging in prone areas or more effectively

27 Target 10 guidelines report that during one lactation a 100 cow herd deposits in the dairy yard 80 kg of phosphorus, 250 kg of nitrogen and 270 kg of potassium.

28 Savings of up to 40% have been reported by the Department of Primary Industries Victoria and a DfT case study reported a $10,000 saving. A more conservative estimate was made because the driver of change was minimising nutrient run off not solely cost savings. Some farmers have also increased pasture production and maintained current fertiliser application rates.

29 J. J. Drewry A B C E ,L. T. H. Newham A ,R. S. B. Greene B C ,A. J. Jakeman A Band B. F. W. Croke A B 2006, A review of nitrogen and phosphorus export to waterways:context for catchment modelling, Marine and Freshwater Research 2006, 58, 757–774

30 Dr Warwick Dougherty, NSW DPI, pers. com. 2007.

31 ABARE 2007 Australian dairy farm survey 07.2

32 Only phosphorus is considered in this report as it has a greater environmental impact in water ways than nitrogen.

sources water from waterways that have been rehabilitated. Water savings have been estimated at 10 ML per farm (5.6 GL across 560 farms).

The counterfactual, or without project investment scenario was considered as the additional time it would otherwise have taken to get the impacts that have been achieved. It would be inappropriate to consider only the withdrawal of Dairy Australia funds from the project, as it was a partnership across many organisations, government agencies and individual farmers. The success of the program can be attributed to all partners and it is unlikely that a similar partnership could have been formed with different players. Consequently, it is assumed that without support form all parties the gains would not have been realised until well into the future. The fact that changes have been made during a period of significant pressure on farm incomes is indicative of the project's success. For the purpose of this evaluation a moderate lead time of 7 years was assumed. Furthermore, DfT On the Ground was a platform project upon which partners will target further farm level environmental outcomes in the future. These benefits are not considered here.

3.4.3 Triple Bottom Line Benefits

Benefits estimated in this section are based on the reported industry impacts in the previous section. These are an additional 105 kms of rehabilitated and managed waterways; 1,120 ha of native vegetation; 63 tonnes of phosphorus prevented from entering waterways; 25% saving in fertiliser costs across 560 farms; and 5.6 GL of water saved each year. Benefits were realised through farm level changes between 2003 and 2007.

Economic

The economic benefits realised by the Australian dairy industry will include the savings from reduced fertiliser use and the value of the water saved each year.

The average annual fertiliser cost per farm has been estimated at $24,000[33] and a 25% saving represents a benefit $6,250. To account for possible on-going management cost a net saving of $5,000 per farm was assumed. Across 560 farms where fertiliser cost savings are likely to have been made, the total industry benefit would be some $2.8m a year.

Water savings have been valued on the basis of the capital cost of water. The price of water entitlements has increased in recent periods because of the supply shortage due to extensive drought conditions across mainland Australia. To reflect a possible return to more normal rainfall patterns and water allocations a market value of

[33] ABARE 2007, Australian dairy, Report 07.2, AGPS

water of $1,500 per ML (capital value of entitlements) with a 96% allocation was assumed[34]. The saving would represent a one-off capital gain for irrigators and was valued at $15,625, on average, per farm. Across the 560 farms where changes have been made the total savings would be $8.8m.

Environmental

Environmental benefits will include improved biodiversity and water quality from better management of riparian lands as well as reduced run-off of phosphorus and increased areas of native vegetation.

Benefits from improved riparian land will accrue to the broader Australian community. To date there has been few studies that have examined the value of improved riparian land management, although investment by both State and Federal governments would suggest that a high value is placed on these areas. For the purpose of this evaluation a one-off $25,000 per km was used for the benefit associated with riparian land management. This estimate was reported by BDA Group in their 2001 evaluation of the Land Water and Wool initiative[35]. Across 105 kms of restored riparian land, this equates to a benefit of $2.6m

The second environmental benefit considered here is the environmental improvement as a result of reduced phosphorus run-off from dairy farms. To derive an estimate of the environmental benefits from reduced phosphorus run-off the NSW load based licensing (LBL) fee structure was used. The fee for phosphorus is $14,280 per tonne. Although dairy farms do not come under the LBL regime as they are a small and diffuse source of pollutants, the LBL fee can provided a minimum estimate of the environmental benefit of reducing phosphorus levels in waterways. On 63 tonnes, the annual benefit or reduced phosphorus run-off would just under $1m.

The final area where environmental gains have been achieved is through the restoration and preservation of f native vegetation areas. Again, few studies have valued the benefits of restoring native vegetation, although a number of initiatives (such as the Victorian government's Bush Tender) provide some indication of the cost of restoring and maintaining areas of native vegetation. Clearly, conservation values will vary significantly from

[34] The average cost of water entitlements was based on an average across the southern Murray Darling Basin for water with a general level of security. Variable costs associated with water use, such as pumping were not included and therefore the value will to some extent underestimate the actual cost saving realised by farmers.

[35] This study used conclusions reported by Van Bueren, M. and Bennett, J. (2000), *Estimating community values for land and water degradation impacts*. A Report Prepared for the National Land and Water Resources Audit Project 6.1.4. Unisearch, University of NSW, Australia. This report assessed the willingness of the Australian community to pay for the restoration of waterways. They estimated a willingness per household to pay $0.08 per 10 km of river restored for recreational use (fishing and swimming) which suggests major water ways. Based on ABS population and housing data and adjusted to reflect a lower amenity value for riparian land on-farms, this equates to a one-off payment of around $25,000 per km of river restored.

region to region and with the type and ecosystem 'health' of each specific area in question. In addition, nominating the appropriate population from which to derive aggregate value estimates is also problematic.

BDA Group (2001 review of the Land water Wool initiative) reviewed a number of studies that sought to value the benefit of restoring areas of native vegetation. They derived an average value of $1,000 per ha based on a choice modelling study of the community willingness to pay for native vegetation protection in the wheat-sheep zone of SE Australia. In this study the reported willingness by NSW households to each pay to preserve remnant native vegetation on private property in the southern Riverina was, on average $0.0003 per ha, and a willingness by Victorian households to pay $.00064 per ha for native vegetation conserved in NE Victoria. These values were multiplied by housing data from the ABS to derive an average value of around $1,000 per ha. This value would be a one-off gain and across 1,120 ha of restored lands the total benefit would be just over $1m.

Social

The main outcome achieved has been the development of the DairySAT tool, which will have on-going application for many years to come. No attempt has been made to quantify the benefits that might be achieved as a result of continued use of the tool in the future. Further, networks developed and demonstration that environmental gains can be achieved in conjunction with economic gains to dairy farmers will make it easier for future investments in this area to succeed in delivering on-ground changes.

Social gains will also be realised as a result of increased farm profitability and the associated economic activity generated in regional areas. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[36] at 54 cents of every dollar of economic benefit captured by dairy farmers

3.4.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australian community, including dairy farmers (as levy payers), the dairy industry as a whole and the Australian community more broadly. In TABLE 21 the distribution of benefits across different sectors is provided.

[36] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

TABLE 21: ESTIMATED INVESTMENT BENEFITS: BY SECTOR: $ MILLIONS

Year	Dairy Farmers	Australia		
		Environmental	Dairy Consumers	Economic Activity
2003	$4.3m	$0.2m	$0.5m	$2.6m
2004	$4.8m	$0.4m	$0.5m	$2.9m
2005	$5.8m	$0.7m	$0.6m	$3.5m
2006	$5.8m	$4.6m	$0.6m	$3.5m
2007	$2.0m	$0.9m	$0.2m	$1.2m
2008 - 2010	$2.0m	$0.9m	$0.2m	$1.2m

Note: From 2010 it was assumed under the counterfactual that benefits would have been realised (i.e. 7 year lag)

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. Measures are reported for costs and benefits realised up to 2014 with all values expressed in 2007 dollars. Because some benefits are described as a one-off value reporting measures for a shorter time period would be misleading. Further, the IRR was not derived because it would have no sensible interpretation given the way that benefits have been described. Also, no benefits are attributed to the investment beyond 2014 because it was assumed that changes would have been made without the Dairy Australia investment after seven years.

The payoff to levy payers was estimated at $13.4m in present value terms or a return of $18 for every dollar invested through the farm levy.

TABLE 22: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	By 2014
PVB	$14.2m
PVC	$0.8m
NPV	$13.4m
BCR	18

Note: PVB is the present value of benefits and PVC is the present value of costs:

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with the Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested. As all benefits have been realised to date, financial sustainability measures are only reported for one evaluation period.

The payoff to dairy farmers on the total investment was estimated at $6.7m in present value terms or a return of $2 for every dollar invested by all partners.

TABLE 23: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date
PVB	$14.2m
PVC	$7.5m
NPV	$6.7m
BCR	2

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs and benefits were converted to 2007 dollars using the consumer price index

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that have been realised by dairy farmers, environmental gains to the wider community, Australian consumers of dairy products and regional economies. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested. As all benefits have been realised to date, financial sustainability measures are only reported for one evaluation period.

TABLE 24: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date
PVB	$30.0m
PVC	$7.5m
NPV	$22.5m
BCR	4

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs and benefits were converted to 2007 dollars using the consumer price index

The payoff to Australia as a whole on the total investment was estimated at $22.5m in present value terms or a return of $4 for every dollar invested by all partners.

3.4.5 Conclusions and Sensitivity Analysis

The investment in DfT On the Ground by all partners was substantial, at nearly $8m by 2007. The pay off on this investment for levy payers was substantial, but when all costs are considered the pay off was estimated to be more modest, at $2 for every dollar invested. This is not surprising given that the main focus was on generating environmental improvements. When benefits to the broader community are included the pay off was estimated to double.

The magnitude of benefits that were attributed to the total investment was conservative. The main driver of pay off will be the assumed counterfactual, or the period over which benefits would have otherwise occurred. Sensitivity analysis was undertaken on this assumption and it was found that the investment would have needed to bring forward change by at least 1.5 years or more to breakeven. The DfT On the Ground investment has been widely accepted as a major change vehicle across the industry, and given the changes achieved and continued interest in developed tools and extension networks, it can be concluded that the investment has delivered a positive return to all parties involved.

3.5 ECO-EFFICIENCY IN MILK PROCESSING

In the mid-1990s there was a fundamental shift in the environmental management attitudes of industry and government. Increasingly, there were attempts to increase the engagement of businesses in developing environmental management systems that sought to deliver environmental outcomes, without compromising the profitability of individual business operations. Dairy Australia was at the forefront of this shift and established the Dairy Manufacturer's Environment Forum (DMEF), which was officially launched in 1997. The DMEF was involved in a range of projects aimed at reducing environmental impacts, for example, packaging selection and disposal, water management, resource use minimization and efficient cleaning regimes.

At about the same time, UNEP Working Group for Cleaner Production was established (in 1996) at the University of Queensland. The primary function of this group was to support manufacturing enterprises profit from better environmental and workplace management changes[37].

The Working Group provided a "clearing house" for information and resources that manufacturing enterprises could use to identify and implement changes to achieve environmental improvements. Through the working Group it was found industry required external expertise and support in carrying out resource efficiency assessments and identifying eco-efficiency opportunities. To this end, the Working Group positioned themselves as a consultancy service for industry. They sought to promote change through the publication and dissemination of case studies that demonstrated the experience and success of innovative companies and by working closely with businesses to identify appropriate strategies.

At the same time many Australian dairy manufacturers were looking at ways to achieve environmental improvements with some manufacturers being very successful in their endeavors. For example, Murray Goulburn established an "energy team" to identify ways to reduce energy consumption at their Rochester site. The team identified 50 different opportunities and were successful in implementing change that led to a $180,000 annual energy cost saving as well a reduction in CO_2 of 1,536 tonnes a year[38].

Realising that manufacturers could be better supported through an industry coordinated program, Dairy Australia commissioned the UNEP Working Group to document best practice across the industry and provide support for manufacturers to identify suitable changes within their own operating environment. This initiative, or project, was called *Eco-efficiency for Australian Dairy Processors* and was guided by a steering committee from Dairy Australia, Bonlac Foods, Warrnambool Cheese and Butter Factory, Dairy Farmers, Murray Goulburn Cooperative, National Foods, Parmalat Australia, Tatura Milk Industries and the Dairy Processing Engineering

37 University of Queensland website – www.gpa.uq.au

38 Eco-Efficiency for the Dairy Processing Industry Manual 2004

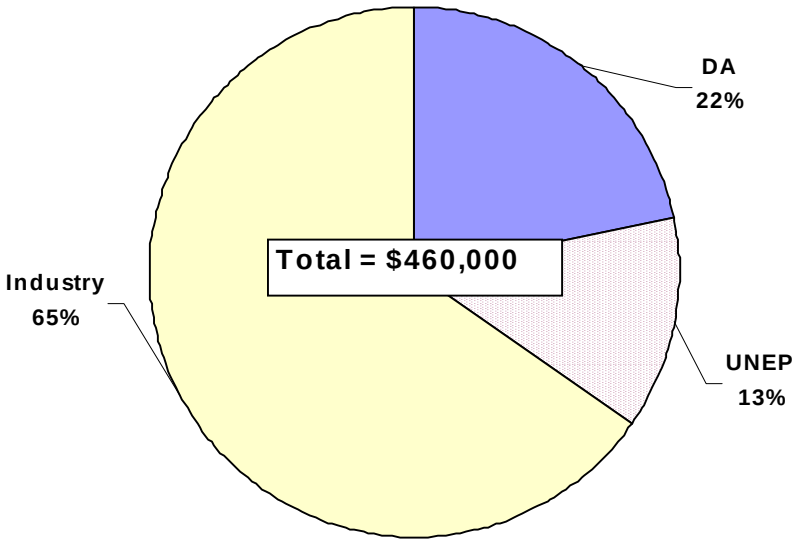
Centre. The project was also actively supported through the Dairy Manufacturers Sustainability Council (DMSC which was formerly known as the DMEF).

3.5.1 Investment Details

The centerpiece of the project was the Eco-Efficiency for Dairy Processing Industry manual that was made available in September 2004. Dairy Australia investment in the development of the manual was approximately $60,000 between 2003 and 2004. The manual is a practical resource for industry to assist businesses to identify and implement changes that are both profitable and deliver environmental improvements. The manual also included a series of fact sheets that covered a wide range of resource use issues including, water management, water recycling and reuse, refrigeration optimisation, boiler operation, utilisation of biogas, use of treated wastewater and yield optimisation and product recovery.

The project also involved considerable support form Dairy Australia and UNEP Working Group staff in 2004 and 2005 in assisting manufacturers on a one-to one basis to work through some of the opportunities covered in the manual. There was also wide-spread support from individual manufactures in the preparation of case studies and broader dissemination of their experiences and success. The total cost of the project (including in-kind contributions from non Dairy Australia partners) was estimated at $460,000 with a breakdown of contributions by different parties shown in Figure 6.

Figure 6: Contribution of Different Parties to the Eco-Efficiency Project



3.5.2 Industry Impact

The project has supported wide-spread change across the industry between 2005 and 2006. There is still on-going change taking place with continued investment in the DMSC and associated activities such as State of the Environment Reporting and the sharing of experiences and success stories across manufacturers. While the Eco-efficiency project has undoubtedly supported on-going change from 2007 no consideration of these changes is made here as these changes can be more rightly attributed to the on-going investment by Dairy Australia and industry.

Between 2005 and 2006 the areas where most manufacturers have implemented change was in water management and water recycling and reuse[39]. Apart from water savings, there was also interest in reducing both nutrient and chemical discharges associated with wastewater. Total water consumption across the industry in 2004/05 has been estimated at 13,500 ML of water and 3,000 ML of condensate. Wastewater volumes are estimated at 15,000 ML across the industry with nutrient and spent chemical loads of 15,000 tonnes of Biological Oxygen Demand (BOD), 370 tonnes of phosphates, 2,500 tonnes of salt in irrigation water and 900 tonnes of salt discharged to sewers[40].

Reported water savings and reductions in wastewater volumes range form 10% to 30% across manufacturers[41]. For the purpose of this evaluation a lower range estimate of 15% was assumed. This saving has been achieved through changes in water management as well as greater recycling and reuse of wastewater. A similar reduction in nutrient and chemical discharges was also assumed. This saving has been achieved through greater separation of chemical and nutrients in recycled wastewater as well as the adoption of improved "clean-in-place' systems that enable cleaning solutions to be recirculated and more effectively utilised.

It is recognised that the eco-efficiency project supported change in some areas of the industry. It is also important to note manufacturers were already showing an eagerness to embrace change prior to 2004 and that a number of government (State and Federal) initiatives[42] were being developed to support change at the industry level. The counterfactual, or without Dairy Australia investment scenario can be described in terms of the extent to which change has occurred across the industry sooner than it would have otherwise. Given the more gradual pace of change achieved in other sectors a three year lag was assumed. That is, without the Dairy Australia

39 Discussions with UNEP staff – it is thought that most manufacturer's current focus is on energy management.

40 DA 2006 Australian Dairy Manufacturing Industry State of the Environment Report, Author Penny Prasad UNEP Working Group for Cleaner Production in the Food Industry. Data estimations are based on the State of the Environment Report which represents 70% of the industry with respect to raw milk processed.

41 Based on reported activities through the DMSC and project participants.

42 Environmental management systems have gradually evolved as a vehicle for change, but in most cases government can not provide an adequate industry interface to promote wide-spread adoption.

investment in the eco-efficiency project it is assumed that such water savings and reductions in chemicals and nutrients in wastewater would have been achieved by 2007 and change would have occurred in an ad-hoc manner through involvement in government programs such as NSW 'Every Drop Counts' and others. However, it should be noted that the current drought situation has hastened the adoption of water conservation measures by the industry. The sensitivity of derived financial sustainability measures to a shorter lag is examined in the final section.

3.5.3 Triple Bottom Line Benefits

Benefits estimated in this report are based on average changes in water consumption and nutrient and chemical discharge across the dairy manufacturing industry. In 2004 there were 70 major dairy manufacturing sites across Australia – 19 in capital cities and 51 in rural areas[40]. The estimated changes on a per site and total industry basis is reported in Table 25. However, some sites would not have made any changes and indeed around 30% did not participate directly in the program. While it might be expected that these operations may have benefited from the Dairy Australia investment, they have not been included in the industry total estimated here.

Table 25: Estimated Changes from Eco-Efficiency Project

Resource or Pollutant	Total Industry Use or Discharge	Estimated Reduction across Industry	Estimated Average Reduction per Site
Water Consumed	13,500 ML	1,418 ML	29 ML
BOD Discharge	15,000 tonnes	1,575 tonnes	32 tonnes
Phosphate Discharge	370 tonnes	39 tonnes	0.8 tonnes
Salt Discharge	2,500 tonnes	27 tonnes	6 tonnes

Note: Only salt discharge to irrigation water is included.

Economic

The economic benefit from reduced water consumption will be based on the reduction in water cost and the cost of implementing in-factory changes. Strategies listed in the State of Environment report[40] to reduce water demand includes, optimising boilers, cooling towers and clean-in-place systems. New equipment has also been purchased to increase water recovery and minimise cleaning needs.

The true cost of ambient water and hot water was estimated at $2.43 per kL and $5.23 per kL[38] respectively in 2004 . This cost includes the purchase price of water, wastewater treatment costs, wastewater pumping costs, a wastewater discharge cost and a heating cost. It was assumed that around 20% of water is hot and therefore the

average cost of water would be some $3.00 per kL. On a reduction of 1,418 ML this represents a saving of $4.3m across the industry or, on average, $88,000 per manufacturing site. While the implementation cost will vary from site to site depending on what changes are made, an up-front capital cost of $44,000 per site was assumed as this was in the range of pay back periods reported by many manufacturing sites.

The "with" and "without" Dairy Australia investment benefits are reported in Table 26. Adoption was assumed over 2005 and 2006. The counterfactual, where it is assumed that changes would have been made without Dairy Australia and partner investment is also reported. In this case, net benefits have been lagged by 3 years. The difference between the industry net benefit and the counterfactual represents the economic gain to the dairy processing sector from Dairy Australia's investment.

Table 26: Estimated Economic Benefits to Dairy Manufacturers

Year	Industry Cost	Industry Benefit	Net Industry Benefit	"Without" Scenario	Project Benefit
2005	$1.1m	$2.2m	$1.1m		$1.1m
2006	$1.1m	$4.3m	$3.2m		$3.2m
2007		$4.3m	$4.3m		$4.3m
2008		$4.3m	$4.3m	$1.1m	$3.2m
2009		$4.3m	$4.3m	$3.2m	$1.1m
2010		$4.3m	$4.3m	$4.3m	

Environmental

Environmental benefits will be realised by the wider community as less nutrients and chemicals are discharged into water ways. The environmental impact of nutrient and phosphate discharge has been quantified using the NSW Load Based Licensing (LBL) fee structure. The LBL fee structure can provide a minimum environmental cost estimate as the fee reflects the environmental damage caused by different pollutants. The LBL fee for BOD is $7 per tonne and $14,280 per tonne for phosphorus. The environmental cost of salt entering waterways was estimated at $32.5 per tonne. This estimate was derived from an ABARE[43] study that examined the benefits of reducing salt loads in the Goulbourn and Broken rivers. The value of the environmental benefit from the Dairy Australia investment is reported in Table 27. A salt benefit was not included as the value of the estimated gain was minimal.

[43] Heaney, A., Beare, S. & Bell, R. 2001, Targeting land and water use options for salinity management in the Murray Darling Basin, ABARE Report to the MDBC, October. Note – the estimated damage cost of $28 per tonne was converted to 2007 dollars using the consumer price index. Also, the estimate is reported in present value terms.

Table 27: Estimated Environmental Benefits to Australia

Year	BOD	Phosphates	Total Benefits	"Without" Scenario	Project Benefits
2005	$0.01m	$0.28m	$0.28m		$0.28m
2006	$0.01m	$0.56m	$0.57m		$0.57m
2007	$0.01m	$0.56m	$0.57m		$0.57m
2008	$0.01m	$0.56m	$0.57m	$0.28m	$0.28m
2009	$0.01m	$0.56m	$0.57m	$0.57m	

Social

Social gains will include consumer benefits from a more competitive dairy sector as well as flow on impacts from increased production across regional areas of Australia. It was estimated[44] that 90% of the economic benefits would be captured by dairy farmers with the remainder largely captured by Australian consumers.

Benefits to regional economies can be described in terms of flow on impacts to regional economies as a result of increased dairy production. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[45] at 54 cents of every dollar of economic benefit captured by dairy farmers.

[44] CRA and BDA Group models are discussed in the Appendix

[45] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

3.5.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australian community, including dairy farmers (as levy payers), all investment partners and the Australian community more broadly. In TABLE 28 the distribution of benefits across different sectors is provided.

TABLE 28: ESTIMATED INVESTMENT BENEFITS: BY SECTOR: $ MILLIONS

Year	Dairy Farmers	Australia		
		Environmental	Dairy Consumers	Economic Activity
2005	$1.0m	$0.3m	$0.1m	$0.5m
2006	$3.0m	$0.6m	$0.3m	$1.2m
2007	$4.0m	$0.6m	$0.4m	$2.1m
2008	$3.0m	$0.3m	$0.3m	$1.6m
2009	$1.0m		$0.1m	$0.5m

Financial sustainability measures derived included the net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR) on the investment made. A discount rate of 5% was used and all dollar values were converted to 2007 dollars using the consumer price index. The following sections present estimated measures by different segments of the Australian community. Two time periods were considered – benefits to date and five years from now. Beyond five years no benefits can be attributed to the investment as it was assumed that changes would have been made by then under the assumed "without" Dairy Australia investment scenario.

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. Measures are reported for costs and benefits realised to date and from 5 years from now.

TABLE 29: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	To date	5 years
PVB	$6.3m	$9.1m
PVC	$0.1m	$0.1m
NPV	$6.2m	$9.0m
BCR	63	91
IRR	499%	501%

Note: PVB is the present value of benefits and PVC is the present value of costs

The payoff to levy payers achieved to date from investment between 2003/04 and 2006/07 was estimated at $6m in present value terms or a return of $63 for every dollar invested through the farm levy. By 2010 the payoff was estimated to reach $9m with a BCR of 91.

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with the Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested.

The payoff to levy payers achieved on all funds invested to date between 2003/04 and 2006/07 was estimated at $6m in present value terms or a return of $13 for every dollar invested through the farm levy. The total payoff to levy payers with benefits included to 2010 was estimated at $9m with a BCR of 18.

TABLE 30: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date	5 years
PVB	$6.3m	$9.1m
PVC	$0.5m	$0.5m
NPV	$5.8m	$8.6m
BCR	13	18
IRR	211%	217%

Note: PVB is the present value of benefits and PVC is the present value of costs:

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that

have been realised by Australian consumers of dairy products and regional economies as well as wider environmental gains. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested.

TABLE 31: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date	5 years
PVB	$11.5m	$16.4m
PVC	$0.5m	$0.5m
NPV	$11.0	$15.9m
BCR	23	33
IRR	307%	311%

Note: PVB is the present value of benefits and PVC is the present value of costs:

The payoff to Australia to date from investment made by all parties between 2003/04 and 2006/07 was estimated at $11m in present value terms or a return of $23 for every dollar invested. The total payoff to Australia with benefits included to 2010 was estimated at $16m or a return of $33 for every dollar invested.

3.5.5 Conclusions and Sensitivity Analysis

Dairy Australia's investment in the Eco-Efficiency project was estimated to have delivered a positive and substantial return to levy payers and the Australian community more broadly. While the investment was modest in size, it was the first time that an industry led and supported initiative was implemented with the explicit purpose of delivering both economic gains to manufacturers and environment gains for the community.

In this evaluation it was recognised that the imperatives for change were evolving during the late 1990's and that the drought conditions experienced across much of rural Australian has probably hastened the implementation of water saving strategies by dairy manufacturers. In this regard the manual and follow-up dissemination and factory visits has prompted change earlier than would have otherwise occurred. The project will also deliver on-going benefits as the industry has been able to strengthen its collaborative approach to environmental management through the DMSC.

To test the robustness of the estimated payoff a shorter lead time was examined. It was found that the total investment to all parties would breakeven on a lead time of less than one year. That is, the investment would still deliver a positive return if the counterfactual, or time period over which change would have occurred without the Dairy Australia investment, was only one year.

3.6 LACTOSE UTILISATION

In the early 1990's the Dairy Research & Development Corporation (DRDC) set up the whey and lactose program. At that time only 50% of cheese whey was recovered with the rest fed to animals, disposed of to land or pumped into reticulated wastewater systems at an average cost of between $2,000 and $5,000 per ML[46]. Growing concerns about possible environmental impacts from whey disposal encouraged dairy manufacturers to recover more whey from waste streams.

By 2004 it was estimated that 88% of whey was being recovered[46]. However, the profitability of recovering whey was marginal and in most cases whey recovery was a breakeven exercise undertaken for the purpose of reducing any potential environmental impacts.

In 1994 a research group was formed to look at ways of economically recovering and utilising valuable components from whey streams. This group included researchers form the University of Western Sydney (UWS) and Food Science Australia (FSA) with support from Dairy Australia (DRDC at the start). The program has been regularly reviewed by Dairy Australia's Lactose Steering committee comprised of Dairy Australia representatives, industry representatives and the research team.

Lactose can be recovered from whey streams but Australia only produces edible lactose and imports the more valuable pharmaceutical grade product. Further, with existing technology about 70% of lactose is recovered[47], and this combined with the lower value product that is produced limits the economic viability of production.

The lactose research team explored different approaches to lactose purification and crystallisation with the aim of:

- increasing purity and yield;
- avoiding residual (mother liquor) waste product;
- realising production costs at no higher than current costs; and
- achieving a zero discharge operation.

Over the past seven years lactose prices have remained fairly stable at around $400 to $600 per tonne. However, in 2007 the price has increased substantially (up to $1,700 per tonne) due to increased standardisation of dairy product (regulations relating to the addition of lactose to skim milk powder), recognition of its value as a

[46] Dr Greg Zadow 2005, Review and report on whey utilisation, Prepared for Dairy Australia, December

[47] Dairy Australia Lactose Program reports

prebiotoc and for an increasing range of applications based on its functionality. This increase is seen by industry as a fundamental shift in demand which will be maintained well into the future.

3.6.1 Investment Details

Since the start of the program in 1994 to 2005 Dairy Australia has provided funding support of over $3m. FSA and UWS have also contributed to the program, at over $6m since inception. The work and achievements of the group include five National awards, publication of two patents, one book chapter, 14 refereed journal papers, 22 refereed conference proceedings and 21 conference presentations. The group has also contributed to the supervision of 10 students in dairy science that has resulted in the granting of 3 PhDs, 1 MSc, 2 honour graduates and 4 MsC Appl. Investment will be made until 2009 as part of the on-going support for commercialisation activities as well as associated work on lactose yield, quality and derivatives. It is anticipated that an additional $3m will invested to 2009 by all partners.

The main research focus has been on the development of alternative technologies for whey purification and crystallisation. The key commercial achievement has been the development of the IEL process that has been patented and was licensed to Groupe Novasep in 2005. This technology improves lactose production by eliminating many of the problems faced by current lactose manufacturers such as calcium fouling of evaporators, poor evaporator efficiency and high cleaning costs. Lactose purity has also been improved with this technology as well as yields.

In 2005 Dairy Australia reviewed the Lactose program and decided to continue its support of the Lactose program, with a shift in emphasis to the commercialisation of the IEL technology, finalising the research, development and commercialisation of the AAC Technology (novel crystallisation process) and developing future areas for lactose and lactose derivatives research.

For the purpose of this evaluation Dairy Australia investment is only included up to 2005 at which time the IEL was commercialised. This technology largely involves the construction of a new plant, at an estimated cost of around $6m. In 2005 the low price of lactose limited the viability of new IEL plants, but since the major increase in lactose prices in 2007 the IEL technology is now more commercially attractive.

3.6.2 Industry Impact

The success of the IEL technology can be seen in the number of new plants built both in Australia and overseas. To date 2 plants have been commissioned in Europe and it is expected that at least a further 6 plants may be

constructed by 2010. The research group and Dairy Australia receive a one-off royalty on each plant built. This royalty is around $1m.

In Australia there are four major lactose producers and although there has been no indication that these producers will adopt the IEL technology in the immediate future it is likely that they may do so once the viability of the technology has been demonstrated in European Plants. Royalties would be generated on each plant built, but lactose production would also become more profitable as both product quality and yield is improved. The yield increase has been estimated at 95% compared to 70% with existing technology[47].

It is not know if international researchers have been developing similar technologies that might compete with the IEL plant commercialised by the Groupe Novasep. Without Dairy Australia investment it would be reasonable to assume that similar technologies would be ultimately developed. The counterfactual, or "without" Dairy Australia (and partner) investment can be expressed in terms of how long it might have otherwise taken for similar plants to become commercially available in Australia. For the purpose of this evaluation it was assumed that there is a five year lag as there has been considerable research effort abroad on lactose recovery, many of the environmental concerns regarding whey disposal in Australia also exist in European countries and that the fundamental shift in lactose prices would accelerate research interest abroad. The counterfactual scenario does not apply to royalties earned on IEL plants constructed in Europe as these royalties would have been earned as competing technologies would not have been available until 2011.

3.6.3 Triple Bottom Line Benefits

In this section benefits are considered on the basis of the construction of IEL plants in Australia and in Europe. Increased profitability of plants in Europe will have no direct impact on Australian dairy farmers except to the extent that royalties are earned. In Australia the increased profitability of dairy manufacturing will have a direct impact on dairy farmers as they are able to capture a large share of the increased profits generated as a result of processing productivity improvements. However, the royalty paid on Australian IEL plants would need to be accounted for in the future profitability of those plants in Australia, and caution is required to ensure that benefits are not double counted. To this end, only the additional profitability of the IEL process over existing production is considered.

Economic

For plants constructed in Europe a royalty of around $1m is paid. This would deliver a total benefit of $8m across the 8 plants that are likely to be built by 2010. This benefit does not accrue directly to Australian dairy farmers, but rather is a benefit to the wider research and development partners.

Benefits realised from use of the IEL technology in Australia has been estimated using current lactose prices and the increased product yield achieved. Australian production is currently around 21,800 tonnes a year and it was assumed that the same inputs are used. As such, the increase in lactose production would be some 7,200 tonnes a year, or on average, some 1,800 tonnes per plant.[48]. Using an average price of $1,500 per tonne into the future (below current levels of $1,700) the total industry benefit would be $10.8m.

The capital cost of constructing the new plant also needs to be considered. This cost is anticipated to be around $6m per plant. To derive an estimate of the capital cost associated with the increased product yield, a value was derived based on the proportionate share of the increased yield compared to total lactose production. Based on efficiency gains noted above total production would be around 29,000 tonnes. The share of the capital cost that can be attributed to the increased yield of 7,200 tonnes is estimated at $1.5m per plant.

Social

Social gains will include benefits to consumers as well as flow on impacts from increased production across regional areas of Australia. It was estimated[49] that 90% of the economic benefits would be captured by dairy farmers with the remainder largely captured by Australian consumers. These benefits relate only to IEL plants operating in Australia.

Social benefits can also be described in terms of flow on impacts to regional economies as a result of increased dairy production. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[50] at 54 cents of every dollar of economic benefit captured by dairy farmers.

[48] Zadow 2005 report quotes Australian production and Dairy Australia staff have indicated that current lactose production in Australia is largely from four major businesses.

[49] CRA and BDA Group models are discussed in the Appendix

[50] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

3.6.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australian community, including dairy farmers (as levy payers), all investment partners and the Australian community more broadly. In TABLE 32 the distribution of benefits across different sectors is provided.

TABLE 32: ESTIMATED INVESTMENT BENEFITS: BY SECTOR: $ MILLIONS

Year	Dairy Farmers	Australia		
		Royalty	Dairy Consumers	Economic Activity
2007		$1m		
2008	$1.1m	$2m	$0.1m	$0.6m
2009	$3.5m	$2m	$0.4m	$1.9m
2010	$5.9m	$3m	$0.7m	$3.2m
2011	$8.4m		$0.9m	$4.5m
2012	$9.7m		$1.1m	$5.2m
2013	$8.6m		$1.0m	$4.7m
2014	$6.2m		$0.7m	$3.4m
2015	$3.8m		$0.4m	$2.0m
2016	$1.4m		$0.2m	$0.7m

Financial sustainability measures derived included the net present value (NPV), benefit cost ratio (BCR) and internal rate of return (IRR) on the investment made. A discount rate of 5% was used and all dollar values were converted to 2007 dollars using the consumer price index. The following sections present estimated measures by different segments of the Australian community. Three time periods were considered – benefits to date and five and ten years from now. Beyond ten years no benefits can be attributed to the investment as it was assumed that similar technologies would have been developed and adopted under "without" Dairy Australia investment scenario.

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. Measures are reported for costs and benefits realised to date and from 5 years and 10 years from now.

TABLE 33: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	To date	5 years	10 years
PVB	$0	$12.6m	$20.2m
PVC	$3.4m	$3.4m	$3.4m
NPV	-$3.4m	$9.2	$16.8m
BCR	na	4	6
IRR	na	17%	23%

Note: PVB is the present value of benefits and PVC is the present value of costs

The payoff to levy payers achieved to date was estimated at negative $3.4m in present value. This is because the investment is not expected to deliver a return to levy payers until the IEL technology is adopted in Australia. By 2016 the payoff was estimated to reach $17m with a return of $6 to levy payers for every dollar invested. The low IRR indicate the long time period over which the investment was made.

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with the Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested.

The payoff to levy payers achieved on all funds invested to 2016 was estimated at $10m in present value terms or a return of $2 for every dollar invested through the farm levy.

TABLE 34: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date	5 years	10 years
PVB	$0	$12.6m	$20.2m
PVC	$10.1m	$10.1m	$10.1m
NPV	-$10.1m	$2.6m	$10.1m
BCR	na	1	2
IRR	na	7%	11%

Note: PVB is the present value of benefits and PVC is the present value of costs:

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that have been realised by research partners, Australian consumers of dairy products and regional economies. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested.

TABLE 35: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date	5 years	10 years
PVB	$0.5	$24.8m	$37.3
PVC	$10.1m	$10.1m	$10.1m
NPV	-$9.6m	$14.7m	$27.2m
BCR	na	3	4
IRR	na	14%	16%

Note: PVB is the present value of benefits and PVC is the present value of costs:

The payoff to Australia to date from investment made by all parties was estimated at negative $9.6m in present value terms. Once the technology is taken up both in Australia and overseas the payoff is estimated to increase to $27m or a return of $4 for every dollar invested by all parties.

3.6.5 Conclusions and Sensitivity Analysis

The estimated payoff from the Lactose program was estimated to be positive, but more marginal to other investments considered in this report. Investment in the program has been made over a long period and adoption of the IEL technology in Australia will be the main driver of the returns for levy payers as well as for Australia more broadly. However, the advantages of the IEL technology appear to be significant and its economic viability will be increased if current lactose prices can be maintained. The breakeven level of adoption was estimated at only one plant in Australia. If this can be achieved then the investment will deliver a positive return.

3.7 NOVEL PRODUCTS FOR JAPANESE MARKET

Export market development is fundamental to the on-going prosperity of the Australian dairy industry. In 2005/06 around 50% of production was exported and Japan represented our main export market, with total exports valued at $442m or 17% of total exports[51]. In global terms, Japan is one of the largest importers of cheese products, yet has relatively low imports of other dairy products because of domestic policies to protect the Japanese dairy industry.

Japanese trade polices for dairy products include tariffs and tariff rate quotas (TRQ). Cheese imports that are not used for further processing in Japan or natural cheese used for further processing can attract a tariff of 29.8%. About half of the imports of natural cheese for processing enters duty free under Japan's local content quota. Most other dairy products are subject to a TRQ where imports outside the quota usually face an ad valorem tariff as well as a specific tariff measured in yen per kilogram. The combination of these high tariffs is to discourage imports in excess of the set quota.[52]

In the early 1980's the Australian dairy industry developed a novel cheese product to meet specific demand in Japan for a high fat product that could be used for the manufacture of products such as confectionery, ice-cream, bakery goods and milk based beverages. This product, Medium Fat Cream Cheese (MFCC) is manufactured using cheese making methods and meets the CODEX definition of cheese as well as the Japanese cheese standard[53]. Innovative products such as MFCC have been able to be developed because they do not come under the Japanese high tariff regime. However, to maintain the high level of protection afforded the Japanese dairy industry the Japanese government continually reviews innovative products, and where appropriate, products are re-classified and brought under the high tariff regime. The strong consumer demand for MFCC in Japan has prompted the Japanese government to periodically review the classification of MFCC. If MFCC were to be brought under the high tariff regime it is likely that this valuable market for Australian dairy would be lost.

In recognition of the importance of market access, Dairy Australia maintains an in-house capability to respond to trade issues that arise through time. The Trade & Strategy group within Dairy Australia is responsible for providing support to industry in the development of product markets and the management of consumer demand overseas. Part of this investment includes bilateral trade representation where Dairy Australia is able take a unified industry position in collaboration with the Federal government to ensure that any changes in domestic policies of our trading partners does not adversely affect the Australian dairy industry. Through Dairy Australia

[51] Dairy Australia 2006, Australian Dairy in Focus 2006.

[52] USDA 2005, Dairy Policies in japan, Electronic Outlook Report from the Economic Research Services, www.ers.usda.gov

[53] Project information provided by DA.

involvement in bilateral trade negotiations, success has been achieved in keeping MFCC classified as a cheese product and not subjected to the higher tariffs for products other than cheese.

3.7.1 Investment Details

Tariff rates for cheese and dairy spreads were conformed by the GATT Uruguay Round in 1995 of which Japan was a signatory. Since that time Japanese authorities have periodically attempted to reclassify MFCC through a series of challenges at the World Customs Organization, Codex Alimentarius and the International Dairy Federation[54]. Dairy Australia, at the request of industry, has coordinated the Australian dairy industry response on MFCC market access issues. This work has involved:

- development of a coordinated industry response to Japanese requests for tests and product information;
- commissioning desk top research to demonstrate the validity of the Australian position on the definition of cheese;
- coordination and financial support for testing of product in Australia and in a number of overseas customs laboratories;
- commissioning research into the validity of specific test methods adopted by Japan; and
- industry representation at meetings and at international forums the funding of the attendance of cheese specialists at many of these meetings. Meetings included the World Customs Organisation, Codex, International Dairy Federation (IDF) and bilateral meetings with Japanese and other countries' industry representatives and Customs representatives.

Over the period 2003/04 to 2005/06 Dairy Australia has invested around $300,000 to support MFCC trade with Japan. Major exporters and the Federal government would have also incurred considerable costs through the provision of in-kind contributions of staff. These costs, for both companies and the government are estimated to be much the same as the investment made Dairy Australia[55].

[54] For example, in 2006 at the 7th meeting of the Codex Committee on Milk and Milk Products, the Australian dairy industry with support by the USA successfully pushed an amendment that prevented cheese being defined by a minimum protein content. (Australian Government Bulletin Food News September 2006)

[55] Companies would also incur costs associated with product development and testing. However, these costs would form part of normal export activities and hence are not included as a cost relevant to the investment made in trade negotiations regarding market access of MFCC in Japan.

3.7.2 Industry Impact

The Dairy Australia, industry and government investment in support of MFCC trade with Japan has prevented MFCC being reclassified and subjected to the high tariff regime. In short, access for this innovative product for Japanese consumers has been maintained. If this market had been lost then exporters would have had to find alternative markets. Few other markets exist for this innovative product, and exporters would have sold the product on the basis of its butter fat content in other markets. On this basis exporters would have lost the premium paid in the Japanese market on the butterfat content of the product.

To determine the total value of the premium obtained on MFCC it was necessary to estimate both the value and volume of MFCC cheese exports to Japan and the export value of the butterfat equivalent of MFCC in other markets. In 2005/06 MFCC trade with Japan was some \$100m[56]. In that year the value of all cheese exports (81kt) to Japan was \$298m. The average export value of Australian cheese to all destinations except Japan was \$4,454 per tonne[57]. If it were assumed that the average value of cheese exports to Japan excluding MFCC was \$4,454 per tonne then export volumes of MFCC would be around 36 kt with a value of \$2,777 per tonne.

If the MFCC trade with Japan were lost then the milk solids use to make MFCC would be sold as different products in other markets and at prevailing world prices. To estimate prices for the butterfat equivalent of MFCC in other markets a valuation was carried out using butter fat as the indicative base value. Most MFCC has a fat content of around 50% compared to butter that has a fat content of 83%. In 2005/06 Australian export prices of butter averaged \$2,724 per tonne. On this price the estimated trade value of the butter fat in MFCC in other markets would be \$1,641 per tonne. Therefore, the premium earned on the butter fat in MFCC in Japan was estimated at some \$1,000 per tonne or \$36m in 2005/06.

The impact of the Dairy Australia and partner investment between 2003/04 and 2005/06 could have a "short shelf life" as there will continue to be periodic challenges to the trade classification of MFCC. For the purpose of this evaluation it was assumed that the investment has enabled MFCC access to Japan for the years 2006/07 to 2008/09. Access in periods before this can be attributed to earlier investment while access beyond 2009 might be attributed to investment that Dairy Australia and others are likely to make from 2005/06 onwards. It is recognised that a three year period might be on the conservative side as the recent success will ensure that market access will be maintained for some time and that future investment in protecting market access of MFCC might be considerably less. However, the investment in MFCC market access has been on-going for many years and it would be reasonable to assume that without Dairy Australia investment other parties might have had some success.

[56] Australian Government (2006), Bulletin Food News, September

[57] ABARE 2006, Australian Commodity Statistics 2006

3.7.3 Triple Bottom Line Benefits

This investment has enabled Australian dairy processors and exporters to capture a premium on the butter fat content of MFCC sold on the Japanese market. This would increase the profitability of Australian dairy manufacturing operations, which in turn leads to an increase in milk demand and prices paid for raw milk. No environmental benefits have been generated under this investment.

Economic

The economic benefit is simply the increased profitability of MFCC sales to Japan compared with sale of the equivalent butterfat content in other markets. This benefit has been estimated at $36m a year, with 90% or $32.4m being passed back to dairy farmers through higher milk prices with dairy consumers capturing the remainder.

Social

Social benefits can be described in terms of flow on impacts to regional economies as a result of increased profitability of dairy operations. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[58] at 54 cents of every dollar of economic benefit captured by dairy farmers.

3.7.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australian community, including dairy farmers (as levy payers), the dairy industry as a whole and the Australian community more broadly. In TABLE 36the distribution of benefits across different sectors is provided.

TABLE 36: ESTIMATED INVESTMENT BENEFITS: BY SECTOR: $ MILLIONS

Year	Dairy Farmers	Dairy Consumers	Economic Activity
2007	$32.4m	$3.6m	$17.5m
2008	$32.4m	$3.6m	$17.5m
2009	$32.4m	$3.6m	$17.5m

[58] Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

Levy Payers

Financial sustainability measures were derived first for levy payers. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. The only two time periods examined is to date and 5 years from now, as beyond 5 years no more benefits have been attributed to the investment.

The payoff to levy payers was estimated at $76m in present value terms or a return of $254 for every dollar invested through the farm levy. The high IRR reflects the short time period over which benefits have been realised and the relatively small costs compared to the benefits generated.

TABLE 37: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO LEVY PAYERS

Measure	To date	5 Years
PVB	$26.7m	$76.2m
PVC	$0.3m	$0.3m
NPV	$26.4m	$75.9m
BCR	89	254
IRR	536%	572%

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs were converted to 2007 dollars using the consumer price index

All Investment Partners

In this section the financial sustainability measures are derived for all investment partners involved with Dairy Australian investment project. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties and benefits only include those that have been realised by dairy farmers. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to dairy farmers from all funds invested.

The payoff to dairy farmers on the total investment was estimated at $75m in present value terms or a return of $85 for every dollar invested by all partners. Again, the high IRR reflects the short time period over which benefits have been realised and the relatively small costs compared to the benefits generated.

TABLE 38: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO ALL INVESTMENT PARTNERS

Measure	To date	5 Years
PVB	$26.7m	$76.2m
PVC	$0.9m	$0.9m
NPV	$25.8m	$75.3m
BCR	30	85
IRR	329%	366%

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs were converted to 2007 dollars using the consumer price index

Australia

The final segment for which financial sustainability measures were derived was the Australian community at large, based on all funds invested by both Dairy Australia and partners. Relevant costs include the total investment made by Dairy Australia as well as investment made by external parties. Benefits include those that have been realised by dairy farmers as well as increased economic activity across regional economies. Financial sustainability measures are reported in the table below and provide an indication of the estimated return to Australia from all funds invested.

TABLE 39: FINANCIAL SUSTAINABILITY MEASURES: RETURNS TO AUSTRALIA

Measure	To date	5 Years
PVB	$44.1m	$125.9m
PVC	$0.9m	$0.9m
NPV	$43.2m	$125.0m
BCR	49	140
IRR	414%	451%

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs were converted to 2007 dollars using the consumer price index

The payoff to Australia as a whole on the total investment was estimated at $125m in present value terms or a return of $140 for every dollar invested by all partners.

3.7.5 Conclusions and Sensitivity Analysis

It was estimated that the investment made by Dairy Australia and others in supporting Japanese market access for novel products has delivered a positive and substantial return on funds invested. No sensitivity analysis was carried out as it is clear that Dairy Australia's contribution to the maintenance of the MFCC market in Japan would only need to be very minor for the investment to breakeven.

3.8 DAIRY FOOD OF LIFE

The Dairy Food of Life (DFOL) national marketing campaign was initiated in 2001 by the Australian Dairy Corporation. After the 2003/04 financial year the DFOL investment was restructured to target emotional values that consumers place on dairy products as well as its value as a nutritious and natural food product. This decision was made on the basis of market research that showed that although consumers had a strong awareness of the primary nutritional messages from the DFOL campaign, consumers did not associate emotional values (such as enjoyment from consuming dairy products) with the campaign. In turn, this was leading to a decline in dairy positive attitudes[59]. Over the years 2004/05 and 2005/06 the DFOL was repositioned to convey to consumers that dairy products were nutritious, natural, contemporary and convenient food possessing desirable emotional values and benefits related to pleasure and enjoyment. By 2006/07 the campaign brand had been changed to "Dairygood for Life" to reflect how Dairy Australia was repositioning dairy products in the eyes of consumers[60].

The DFOL campaign was targeted at domestic consumers. These consumers account for some 50% of all milk produced in Australia, with 20% consumed as drinking milk and 30% consumed as processed dairy products (such as cheese, butter and powders)[61]. Apart from the direct impact on consumer behaviour that the DFOL campaign sought to achieve, the campaign also provided a platform upon which individual dairy processing companies could leverage their own products[62]. To ensure that maximum leverage could be obtained by Australian dairy companies the DFOL campaign was developed and implemented by Dairy Australia on a consultative basis with industry.

3.8.1 Investment Details

The DFOL campaign involved a range of educational and marketing material delivered through a range of different media and events, including:

- Consumer advertising – via television and magazines with the target audience of female grocery buyers,
- Dairy cooking segments on Fresh TV aimed at national audiences.
- Consumer public relations exercises and in-store point of sale promotions.

[59] The 2004/05 National Marketing Group development Plan reports conclusions form a DFOL tracking study (Sweeney 2004) and a SBA 2003 Dairy Brand Image Dipstick report.

[60] In response to prolonged drought conditions and greater take up of marketing by diary processing companies DA has refocussed the National Marketing Program under the current 2008-200121 strategic plan.

[61] Dairy Australia 2006, Australian Dairy Industry In Focus 2006, Melbourne.

[62] Dairy Australia 2003/04 Annual Report, Page 14.

- Educational brochures and recipe booklets.

Each year the DFOL campaign was reviewed and improvements made to increase both the reach and frequency of campaign material across the target population. The cost of the campaign was largely carried by Dairy Australia, at around $3m a year. The value of Dairy Australia's investment between 2003/04 and 2005/06 is provided in TABLE 40.

TABLE 40: DFOL INVESTMENT: $M

2003/04	2004/05	2005/06
$3.5m	$2.0m	$2.5m

3.8.2 Industry Impact

In 2004 Dairy Australia reported that through a range of Dairy Australia and industry activities aimed at Australian dairy product consumers and those who influence them, the past 10 year decline in the average per capita consumption was reversed. There was a recorded increase in 2003/04 in total Australian dairy product consumption of 3.3% and a similar increase in the value of sales[62]. The DFOL campaign was seen by industry as a contributor to the recorded gain in domestic consumption of dairy products.

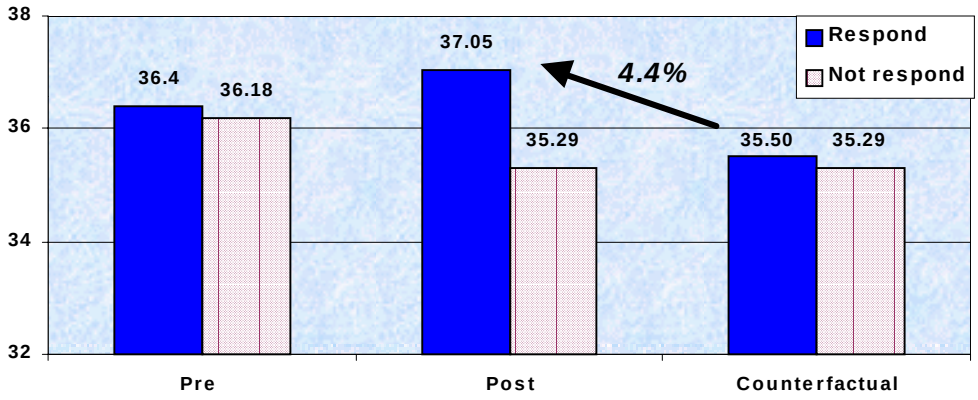
The industry impact of the DFOL campaign that can be attributed to Dairy Australia's investment can be measured by the extent that consumers changed their purchasing behaviour as a direct response to the DFOL campaign. While it is recognised that consumers might also change their mix of the different types of dairy products consumed, it is not clear what changes (if any) in overall processing profitability might have eventuated. Consequently, the analysis here has focussed only on the increase in demand as given volumes of dairy product consumed.

No quantitative study has been completed on changes in consumer behaviour from the DFOL campaign. In 2007, however, Dairy Australia undertook an evaluation of the Dairygood for Life campaign that was run in the second half of 2006. This evaluation was used to derive an estimate of the increased demand that has occurred under previous DFOL campaigns.

In FIGURE 7 the change in average household consumption of dairy products is shown for the three month period (Pre) before the campaign launch and for the three month period (Post) during the campaign. Household data was sourced from Nielson's "homescan" household tracking survey. The survey is demographically representative of the Australian population and is used to measure changes in purchasing patterns through time. To isolate behaviour changes attributed to the Dairy Australia campaign households were separated into those

that responded (were able to recall the Dairy Australia advertisements ***and*** the correct message being delivered) and those that did not respond (could not recall the Dairy Australia advertisement ***or*** the message being delivered).

FIGURE 7: CHANGES IN CONSUMER PURCHASES OF DAIRY PRODUCTS ATTRIBUTED TO DAIRY AUSTRALIA INVESTMENT



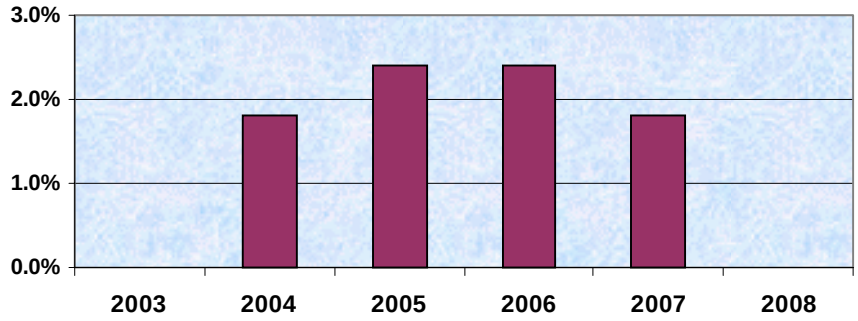
The counterfactual shown in FIGURE 7 assumes that the consumers who responded to the Dairy Australia campaign would have had the same proportional change in consumption as those consumers who did not respond to the Dairy Australia campaign. That is, without the Dairy Australia campaign it is likely that consumption of dairy products would have fallen for all households. Instead, those consumers that responded to the Dairy Australia campaign actually increased their average household consumption (by weight) of dairy products by some 4.4% than would have otherwise been the case. No data was available on specific product mixes so it has been assumed that this average increase applies equally to drinking milk and processed dairy products (including imports).

Dairy Australia in the 2007 campaign evaluation also commissioned MillwardBrown to undertake a consumer tracking survey to measure the reach of the campaign across the target audience. Their results indicated that awareness reached 64% of the target population, which compared to an awareness rate of 56% for the DFOL campaign material. Further, for those consumers who were aware of the campaign material 86% remembered that the advertisements were for dairy foods. Therefore, the estimated demand increase of 4.4% would apply across 55% of households. Across the entire industry this demand increase would translate to just over a 2.4% gain.

Household tracking data was only for the three month period over which the campaign was run. The data provides no indication as to the extent that increased consumption has been maintained into the future. For the purpose of this evaluation it was assumed that the change in purchasing behavior could be sustained for at least

nine months, at which time the next year's campaign would be launched. Over the three years of the DFOL campaign demand would therefore increase by the full 2.4% in the second and third year and fall to 1.8% in the first year and the year immediately following the end of the three year campaign. By the second year after the end of the campaign no change would be maintained. This scenario is shown in Figure 8. Basically, the campaign builds up demand in year one, maintains the increase over years two and three and then without the campaign demand falls away in year four. This is consistent with the strategy to run the campaign every year and the observed increased in consumer purchases of 2.4%.

Figure 8: Assumed Impact of DFOL on Domestic Demand for Dairy Products



3.8.3 Triple Bottom Line Benefits

Benefits estimated in this section are based on changes in domestic consumption of dairy products that can be attributed to the Dairy Australia investment in the DFOL campaign. Annual consumption figures for manufactured dairy products were converted to milk equivalents so that consumption across different product types could be described in a standard unit. Domestic dairy consumption data presented in Table 41 also includes imported dairy products. Consumption in 2006/07 was assumed to be the same as in 2005/06.

Table 41: Australian Consumption of Dairy Products: ML Milk Equivalents

Dairy Product	2003/04	2004/05	2005/06
Australian Production			
Drinking Milk	1,981	2,024	2,065
Manufactured Milk	5,038	5,366	5,046
Imports	1,024	1,155	1,340

Source: Derived From ABARE 2006 Australian Commodity Statistics and DA 2006 Australian Dairy Industry in Focus 2006.

Economic

The impact of the DFOL campaign was to increase the demand for dairy products by Australian consumers. The total increase in Australian demand for dairy products was quantified in milk equivalents using farm gate prices[63].

A baseline increase in demand of 1% was estimated to increase prices to the extent that dairy farmers would collectively realise a $1.5m benefit[64]. to would be delivered to levy payers levy payers and $87m to consumers. The latter also includes consumer gains from increased demand for imported products. A 2.4% increase in demand would generate a benefit for dairy farmers of $3.6m and $209m for consumers.

As mentioned previously, it is likely that Australian dairy manufacturers would be able to leverage off the generic advertising campaign and generate cost savings on their own marketing expenditures. No attempt has been made to quantify such benefits and therefore the economic gains will be underestimated.

Social

Social benefits can be described in terms of flow on impacts to regional economies as a result of increased profitability of dairy operations as well as the consumer gains estimated earlier. Dairy production will increase as a result of greater profitability realised through Dairy Australia's investment. For every dollar of economic benefit captured by Australian dairy farmers, production, as measured by milk revenue, will expand by an estimated $1.13. The increased profit earned on this extra production is included in the farm level benefits estimated earlier. However, this increased production will generate additional demand for dairy inputs, including employed labour. The additional economic activity was estimated[65] at 54 cents of every dollar of economic benefit captured by dairy farmers.

There might also be health benefits associated with increased consumption of dairy products across some members of society. While these benefits are recognised no attempt was made to quantify then here.

63 CRA 2006 estimated that the distribution of gains between consumers, processors and dairy farmers was the same irrespective of where in the supply chain the initial gain was first realised. Increased demand for dairy products will have an impact on both consumer and producer surplus, which reflects the gain that is generated. To convert a demand increase into an initial price change BDA Group's economic model of the Australian dairy industry was used. Details of this model and distribution estimates reported by CRA 2006 are provided in the Appendix.

64 The economic model described in the appendix was used for this purpose. Gains are measured in terms of consumer and producer surplus and were estimated on a 1% increase in the average annual domestic consumption of dairy products, in milk equivalents, over the years 2003/04 to 2006/07

65 Derived from ABS Input-Output Tables for Dairy – Cat. 5209.0.55.001

3.8.4 Financial Sustainability Measures

Financial sustainability measures were estimated across different sectors of the Australian community, including dairy farmers, the dairy industry as a whole and the Australian community more broadly. Measures were derived using the annual benefits estimated above. These include $3.6m to dairy farmers, $209m to Australian dairy consumers and $0.8m in regional economic activity in the second and third year of the campaign. In the first year and year following the campaign benefits were estimated at $2.7m and $157m for dairy farmers and consumers respectively.

Levy Payers and Australia

Because Dairy Australia was the only organisation that incurred costs only the returns to levy payers and Australia at large was considered. Relevant costs include payments made by growers via the output levy on dairy production and relevant benefits to levy payers include only those gains to dairy farmers. Financial sustainability measures are reported in the table below. Only one time period (to date) was considered as all benefits have been realised by 2007. Also, the IRR was not calculated because costs and benefits are realised in the same year and hence an annualised IRR can not be sensibly derived.

TABLE 42: FINANCIAL SUSTAINABILITY MEASURES: LEVY PAYERS & AUSTRALIA

Measure	Levy Payers	Australia
PVB	$8.9m	$530.0m
PVC	$7.6m	$7.6m
NPV	$1.3m	$224m
BCR	1.2	70

Note: PVB is the present value of benefits and PVC is the present value of costs: All costs were converted to 2007 dollars using the consumer price index

It was estimated that the minimum pay off to levy payers would be around $1.3m. When benefits across Australia at large are considered the pay off is more significant, estimated at $224m in present value terms or a return of $13 for every dollar invested.

3.9.5 Conclusions

Investments that seek to build demand are unlikely to deliver significant gains to dairy farmers as any increase in demand can be met through a diversion of product from export to local markets. Greater gains are likely to be realised if dairy manufactures can leverage off demand any generic demand building activity. On the other hand, only a relatively small increase in demand will lead to significant consumer gains as the extra demand can be met without any significant increase in prices paid by consumers.

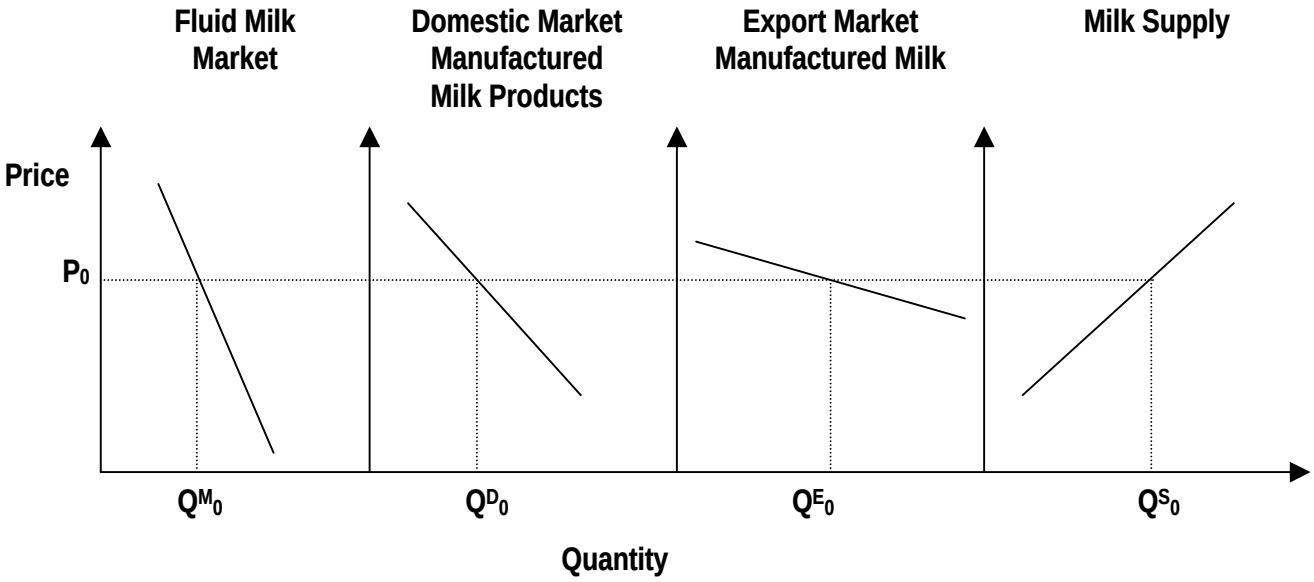
APPENDIX

Dairy Australia commissioned CRA (2006) to derive estimates of the distribution of investment benefits between dairy farmers, processors and consumers. CRA used coefficients from models developed in the past for Dairy Australia by BDA Group and CIE. Distributions used in this study are based on the BDA Group model which is described below.

Investment in Research and Development can result in productivity gains in an industry or increase the demand for commodities or services produced. In the dairy industry R&D benefits will ultimately be distributed between farmers, processors, input suppliers and consumers. Because the focus of the evaluation is on DRDC's investment in R&D, it is necessary to determine the distribution of benefits across different industry participants so that only those benefits which accrue to DRDC stakeholders are considered. Distributions to dairy farmers from productivity increases were based on CRA's estimate of 90% with the remainder largely accruing to consumers and Australian dairy manufacturers. Distributions to consumers and farm gains from demand increases were estimated using BDA Group's model of dairy demand and supply. This model is discussed below.

Much of the literature on the distribution of benefits from R&D is based on the early work of Freebairn, Davis and Edwards (1982). Their work illustrated an approach to measuring R&D benefits in terms of the changes in economic surplus as a result of productivity gains or demand shifts at various stages from primary production to consumption. The fundamental concept to this approach is that in a competitive market increased production efficiency, or increased product demand, will have an impact on prices.

FIGURE 1: DEMAND AND SUPPLY OF MILK AT THE FARM LEVEL



In an article Freebairn (1992[66]) demonstrated that aggregate R&D benefits under free market assumptions and current regulation policy were similar, but the distribution between farmers and consumers was significantly different.

For the purpose of this evaluation, a model of milk demand and supply was constructed to determine the distribution of R&D gains between farmers and consumers of milk products. A free market model was used, following Freebairn (1992), and is depicted in Figure 1.

The partial equilibrium model is based on the (derived) demand for fluid milk, manufactured milk on the domestic market and manufactured milk on the export market. Supply is aggregated across all production regions of Australia.

Supply of all non-milk inputs is assumed to be perfectly elastic and manufacturing of milk is a constant input-output relationship between farm milk and all final products.

Demand and supply are given by:

Fluid Milk Demand Equation:

(1) $P_0 = \beta^M Q^M_0 + \gamma^M$

where P_0 = Initial equilibrium price
$\beta^M = (P_o/Q^M_0)(1/e^M)$
Q^M_0 = Initial equilibrium demand
e^M = Demand elasticity
$\gamma^M = (P_o - \beta^M Q^M_0)$

Domestic Manufactured Milk Demand Equation:

(2) $P_0 = \beta^D Q^D_0 + \gamma^D$

where P_0 = Initial equilibrium price
$\beta^D = (P_o/Q^D_0)(1/e^D)$
Q^D_0 = Initial equilibrium demand
e^D = demand elasticity
$\gamma^D = (P_o - \beta^D Q^D_0)$

Export Manufactured Milk Demand Equation:

(3) $P_0 = \beta^E Q^E_0 + \gamma^E$

where P_0 = Initial equilibrium price
$\beta^E = (P_o/Q^E_0)(1/e^E)$
Q^E_0 = Initial equilibrium demand
e^E = demand elasticity

66 Freebairn,J. (1992), "Evaluating the Level and Distribution of Benefits from Dairy Industry Research", *Australian Journal of Agricultural Economics*, 36 (2), 141-165.

$\gamma^E = (P_o - \beta^E Q^E_0)$

Supply Equation:

(4) $P_0 = \beta^S Q^S_0 + \gamma^S$

where P_0 = Initial equilibrium price
$\beta^S = (P_o/Q^S_0)(1/e^S)$
Q^S_0 = Initial equilibrium supply
e^S = supply elasticity
$\gamma^S = (P_o - \beta^S Q^S_0)$

Initial Producer Surplus (PS_o)*:*

(5) $PS_o = 0.5Q^S_0(P_o - \gamma^S)$

Initial Consumer Surplus (CS_o) *:*

(6) $CS_o = CS^M_0 + CS^D_0 + CS^E_0$

(7) $CS^M_0 = 0.5Q^M_0(\gamma^M - P_0)$

(8) $CS^D_0 = 0.5Q^D_0(\gamma^D - P_0)$

(9) $CS^E_0 = 0.5Q^E_0(\gamma^E - P_0)$

R&D will result in an outward shift in the derived demand for milk or a downward shift in the supply of milk. New equilibrium prices and production / consumption are given by:

Post-Shift Milk Price

(10) $P_1 = [-\beta^S(\gamma^M - a)/ \beta^M - \beta^S(\gamma^D - b)/ \beta^D - \beta^S(\gamma^E - c)/ \beta^E + \gamma^S - d]/[(1 - \beta^S(1/\beta^M + 1/\beta^D + 1/\beta^E))]$

where P_1 = Post shift equilibrium price
a = shift in fluid milk derived demand (price)
b = shift in domestic manufactured milk derived demand (price)
c = shift in export manufactured milk derived demand (price)
d = shift in milk supply (price)

Post-Shift Milk Production / Consumption

(11) $Q^S_1 = Q^M_1 + Q^D_1 + Q^E_1$

where Q^S_1 = Post shift equilibrium milk production
Q^M_1 = Post shift equilibrium milk production for fluid milk market
Q^D_1 = Post shift equilibrium milk production for domestic manufactured milk market
Q^E_1 = Post shift equilibrium milk production for domestic manufactured milk market

(11) $Q^M_1 = (P_1 - \gamma^M + a)/ \beta^M$

(12) $Q^D_1 = (P_1-\gamma^D+a)/\beta^D$

(13) $Q^E_1 = (P_1-\gamma^E+a)/\beta^E$

Post-Shift Producer Surplus (PS_1) *:*

(14) $PS_1 = 0.5Q^S_1(P_1-\gamma^S-d)$

Post-Shift Consumer Surplus (CS_1)*:*

(15) $CS_1 = CS^M_1+ CS^D_1+ CS^E_1$

(16) $CS^M_1 = 0.5Q^M_1(\gamma^M-P_1+a)$

(17) $CS^D_1 = 0.5Q^D_1(\gamma^D-P_1+b)$

(18) $CS^E_1 = 0.5Q^E_1(\gamma^E-P_1+c)$

Change in Producer Surplus (ΔPS) *:*

(19) $\Delta PS = PS_1 – PS_0$

Change in Consumer Surplus (ΔCS) *:*

(20) $\Delta CS = CS_1 – CS_0$

Change in Economic Welfare (TS)*:*

(21) $TS = \Delta PS + \Delta CS$

Change in Surplus - Australia (TS^A)*:*

(22) $TS^A = \Delta PS+CS^M_1-CS^M_0+CS^D_1–CS^D_0$

BDA Group's model was updated to reflect current production levels and prices.

P_0 = 33.0 cents per litre

Q_0 = 10,000 million litres

Q^M_0 = 2,000 million litres

$Q^D_0+Q^E_0$ = 8,000 million litres

$Q^E_0/(Q^D_0+Q^E_0)$ = 50%

e^M = -0.12

e^D = -0.40

e^E = -20.00

e^S = 1.10