
Bio-Dynamic and Conventional Irrigated Dairy Farming in Australia : an Economic Analysis ^[1]

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1. Introduction

In 1989 a project was started by the Department of Agriculture in Victoria, Australia, comparing six bio-dynamic (b-d) dairy farmers with a conventionally farming neighbour. The number of farmers was later expanded to ten pairs. The survey was to run for three years and measure a number of soil, plant and animal characteristics. A financial comparison between the bio-dynamic dairy farmers and their conventionally farming neighbours was required as part of the project for the years 1980-90, 1990-91 and 1991-92.

The final number for this survey was seven pairs of farms. Details of the whole study are contained in a report to the funding body, the Dairy Research and Development Corporation, and have never been officially published. In the absence of more recent data, and with current interest in organic agriculture as witnessed by an attempt to establish a CRC for organic agriculture, it seems appropriate to bring work carried out in the past into the public domain so that it can contribute to a more informed debate.

The financial comparison was to be carried out such that the results could be compared with a previous study undertaken by a consultant ([ACIL](#)) for the Victorian Dairy Industry Authority (VDIA) for the year 1989-90, and with VDIA estimates for 1990-91 and 1991-92. The purpose of the ACIL study was to calculate the total costs of producing a litre of milk. In Section 2 the cash costs of producing a litre of milk by the bio-dynamic farmers and the conventionally farming neighbours are reviewed.

In addition to the calculation of production costs as estimated in the ACIL study, the data were rearranged so that they could also be compared with the results of dairy industry surveys conducted by the Australian Bureau of Agricultural and Resource Economics ([ABARE](#)) (Section 3). This allows for a comparison of the whole farm situation, both in terms of total cash receipts and costs, and in terms of non-cash costs.

A statistical analysis was undertaken to establish statistical differences between the two groups of farmers for some key variables. Where differences are statistically significant a special mention is made.

In this survey only on-farm costs and returns to farmers are examined. Those costs associated with dairy farming which do not affect the returns to farming (such as off-farm environmental costs) are not included.

2. Cash Cost of Milk Production

In this Section cash costs are discussed for seven pairs of farms, and compared with the figures in the ACIL study of 1989-90, and with VDIA's estimates of costs for 1990-91 and 1991-92. VDIA's estimates are based on ACIL's figures for 1989-90, and take into account the price changes on farms (inflation). They do not show productivity changes or changes in inputs used.

The **total cash costs** of producing milk are shown in Table 1 (1989-90, 1990-91, 1991-92 and the average for the three years), for both the cost per farm and per litre of milk. The first and fourth columns show ACIL's or the VDIA's averages. For 1989-90 figures for the local region, the Goulburn Murray Irrigation District (GMID), are used. For 1990-91 and 1991-92 those were not available, so that average figures

for the whole of Victoria are employed for the comparison.

For all three financial years the total cash costs **per farm** for dairy production were considerably lower on the b-d farms than on the conventional farms (between 33 and 40 per cent lower for the three years). The region or state averages were higher than the figures of the b-d farms, and lower than those of the conventional farms. The cash costs of producing milk **per litre** are 16.1 c/L on b-d farms as compared with 14.0 c/L in 1989-90; 14.7 c/L as compared with 13.5 c/L in 1990-91; and 14.8 c/L as compared with 14.4 c/L in 1991-92. However, the differences are not statistically significant.

Table 1: Total cash costs and costs per litre of milk on dairy farms in Victoria

	Total cash costs (\$)			Costs per litre (cents)		
	Victoria	B-D	Conv	Victoria	B-D	Conv
TOTAL OVERHEAD COSTS						
1989-90	12160	11463	13086	2.70	3.50	2.44
1990-91	12272	10355	14743	2.90	2.97	2.38
1991-92	12594	9024	13501	2.98	2.53	2.12
Average	12342	10280	13777	2.86	3.00	2.31
TOTAL PLANT COSTS						
1989-90	8872	8806	9705	1.97	2.55	1.58
1990-91	9751	7789	12820	2.31	2.27	1.92
1991-92	10326	9758	13184	2.44	2.29	2.21
Average	9650	8785	11903	2.24	2.37	1.90
TOTAL FEED COSTS						
1989-90	26572	15608	33087	5.90	4.49	5.34
1990-91	23623	15112	31862	5.58	4.29	4.92
1991-92	23352	18416	35906	5.52	5.01	5.37
Average	24516	16379	33618	5.67	4.60	5.21
TOTAL HERD COSTS						
1989-90	5495	3981	6152	1.22	0.93	0.97
1990-91	5885	3403	6652	1.39	0.84	0.98
1991-92	5944	3397	7819	1.41	0.79	1.06

Average	5774	3594	6874	1.34	0.86	1.00
TOTAL SHED COSTS						
1989-90	5314	5376	5180	1.18	1.56	0.94
1990-91	4675	5441	5402	1.11	1.47	0.89
1991-92	4776	5067	5849	1.13	1.40	0.90
Average	4922	5295	5477	1.14	1.48	0.91
TOTAL SELLING COSTS						
1989-90	10449	8652	13352	2.32	2.30	2.32
1990-91	1544	8555	13518	0.37	2.24	2.19
1991-92	1641	8911	14236	0.39	2.23	2.25
Average	4545	8706	13702	1.02	2.26	2.25
TOTAL LABOUR COSTS						
1989-90	3738	2966	4367	0.83	0.80	0.44
1990-91	3067	2679	1817	0.73	0.66	0.23
1991-92	3266	1922	3768	0.77	0.53	0.44
Average	3357	2522	3317	0.78	0.66	0.37
TOTAL CASH COSTS						
1989-90	72601	56852	84762	16.12	16.13	14.03
1990-91	60816	53334	86646	14.38	14.73	13.51
1991-92	61899	56494	94263	14.63	14.79	14.36
Average	65105	55560	88557	15.04	15.22	13.97

The main differences in expenditure on b-d and conventional farms, apart from milk **selling charges** (directly related to litres of milk) and **shed costs** (related to number of cows, which was lower on b-d farms; see Table 2) are related to **feed and herd costs**.

In the **feed** category, b-d farmers spent more money on purchased fodder, but conventional farmers spent considerably more on fertilisers, agistment and, in particular, on feed concentrates (mainly grains). More costs are incurred by conventional farmers also on irrigation and drainage, cropping (with the exception of 1990-91) and weed and pest control. However, the differences between the two groups of farmers for those items are considerably less in absolute terms than for the concentrates. In terms of cents per litre, only expenditure on fertiliser and weed and pest control are statistically significantly different in all three years. Expenditure on purchased fodder was significantly higher on conventional farms in 1991-92 only.

Of the **herd** cost, those related to calf rearing and especially to animal health are considerably different between the two systems. Although also conventional farmers feed their calves with milk 'from the vats' they tend to use calf pellets more than the b-d farmers. However, the major difference in costs is in animal health, details of which are documented by [McDonald and Small \(1991\)](#). When measured in cost per litre of milk, animal health was the only variable which was statistically significantly different.

In **summary**, the total cash cost on b-d farms are lower than, or similar to, those on the conventional neighbours' farm. When measured per litre of milk the total cash cost cannot be shown to be statistically significantly different between the two systems.

3. Returns to Farming

The total costs per farm or per litre of milk don't give an indication of the returns to farming. Net returns, that is, gross returns minus costs, is an important measure for the viability of a farm.

In Table 2 the returns to farming are shown, in addition to some physical characteristics, as calculated according to the methods used by ABARE ([Campbell 1981, pp.47-57](#)).

Table 2: Physical and financial data for dairy farmers in Victoria (1989-90, 1990-91 and 1991-92)

	ABARE	B-D	Conv.	ABARE	B-D	Conv.	ABARE	B-D	Conv.
	1989-90			1990-91			1991-92		
Total farm area (ha)	128	125	104	146	124	108	137	111	108
Effective dairy area (ha)		69	70		65	72		63	72
Number of dairy cows (no.)	123	113	131	128	121	135	128	118	134
Total milk ('000 l)	457.7	372.3	582.7	483.7	381.3	625.7	477.0	401.6	640.5
Milk per cow (l)	3629	3505	4414	3580	3240	4626	3588	3456	4777
Milk per ha (l)		5465	8426		6111	9022		6554	9358
Labour used (weeks)	120	117	126	114	119	139	111	119	132
Total Cash receipts (\$)	149091	107453	175065	138424	93583	158139	143000	109123	188310
Total Cash Costs (\$)	102167	75104	98758	98281	70297	106151	100630	72181	114549
Farm Cash Operating Surplus (\$)	46924	32349	76307	40143	23286	51988	42380	36942	73761
Change in trading stocks (\$)	4123	4836	3792	3451	3371	3400	4910	1599	6497
Depreciation (\$)	11911	13932	13146	12125	10584	11310	13400	10305	10426
Operator and family labour (\$)	29840	25153	26650	32270	28935	30232	34790	31323	31406
Return to capital and management	9296	1900	40304	-801	-12862	13846	-900	-3088	38425

Interest and rent (\$)	18743	15009	11554	19504	13021	16317	17400	14531	19249
Return to resources (\$)	28039	13109	51857	18703	159	30164	16500	11444	57674
Rate of return to resources									
-per hectare dairy (\$)	219	207	740	128	-42	459	120	114	793
-per capital invested (%)	3.0	3.5	11.7	2.2	-0.4	7.3	2.1	2.1	12.3

Source ABARE data: ABARE(1992and1993).

Note:

-ABARE figures for whole farm, including non-dairy.

-Figures for b-d and conv. farmers: figures per effective dairy area except the 'total farm area', which is total actual area.

However, not all figures are strictly comparable. ABARE's figures relate to the total farm, with averages for the whole of Victoria, while in this study an effort was made to estimate costs of only the dairy component of the farm. In fact, four of the seven b-d farmers had some beef cattle in 1989-90 (five in 1990-91, and four in 1991-92) while only one conventional farm carried beef. A few farmers in this study did off-farm contract work which was not included in the data (neither for costs such as machinery and labour, nor for income), whereas these costs and returns are included in ABARE's figures. The returns to resources are calculated by ABARE on a per hectare operated basis, but for the purpose of this survey on the basis of an effective hectare used for dairy (calculated as the permanent pasture plus half the annual pasture and one tenth of the dryland pasture).

The average total farm area in the ABARE-survey is larger than that of the two groups of farms studied in this report. The values for number of cows, total litres of milk and milk per cow are between those of the b-d and conventional farms. Only the labour input, although ABARE's figure also includes non-dairy related activities, is close to that of b-d farming (more in 1989-90, and less in the other two years, for the ABARE farms), with the conventional farmers in this study using considerably more labour.

Financial returns consist of a cash and a non-cash (imputed costs) component. The total cash receipts (milk income net of freight, sale of dairy stock, and rebates) minus the total cash costs (which are the costs as calculated in Section 2, plus stock purchases and interest paid) make up the farm cash operating surplus.

The **total cash receipts**, closely related to the total litres of milk produced, are considerably lower on the b-d farms than on the conventional farms. The figures are around 60 per cent of the conventional measure in all three years under consideration. The same picture emerges for the **total cash costs**, which is on b-d farms between 63 and 76 per cent of those on conventional farms. The result is a **farm cash operating surplus** on b-d farms which is between 42 and 50 percent of that on the conventional farms.

Interestingly, ABARE's figures for cash costs and returns are, like ACIL's, between those of the two groups of farmers (with the exception of cash costs in 1989-90), although the total cash costs of ABARE's sample are close to those of the conventional farmers.

To arrive at a figure for return to capital and management (that is, the figure left when all cash and non-cash costs are deducted, and which can be seen as payment for capital invested and management skills), the farm cash operating surplus needs to be adjusted for:

- change in trading stock;
- depreciation of vehicles, machinery and equipment;
- operator and family labour.

The absolute difference between the two farming systems does not change drastically when the **change in trading stocks, depreciation and family labour** are deducted from the farm cash operating surplus, to give the **returns to capital and management**. This figure still includes interest and rent payments. Those payments are between \$11,000 and \$20,000 per year (with b-d farmers paying more than the conventional farmers in 1989-90 and less in the other two years).

When deducted, the final figure which measures the return to farming, **the return to resources**, is considerably higher for the conventional farms on a whole farm basis. The difference between the two systems varies somewhat between the years. In 1989-90 the difference was approximately \$38,500, in 1990-91 \$30,000, and in 1992-93 \$46,000.

The figures of the last two years should be treated with caution, as some part of these figures can be contributed to the difference in price of milk one pair of farmers obtained. Due to marketing arrangements (starting in July 1990) in New South Wales (where one pair of farmers lived), one conventional farmer delivered milk under quotas, while the b-d counterpart did not.

This resulted in an average price per litre of milk of 7.2 c/L and 10.7 c/L in 1990-91 and 1991-92, respectively, the higher price being paid to the conventional farmer. If both farmers of this pair had received the prices obtained by the b-d farmer (which would also have brought the average prices received by the two groups to the same level) the differences in the returns to resources between the two group of farmers would have been \$18,500 (instead of \$30,000) and \$27,300 (instead of \$46,000) for 1990-91 and 1991-92, respectively.

However, producing milk most of the year, a requirement for being able to deliver under quotas, is likely to increase production costs. The above calculation is therefore rather simplistic. It is meant to illustrate the point that part of the difference between the two systems of farming could well be due to a difference in marketing, and not necessarily to production possibilities.

As the farm sizes of the two groups are not equal it seems more useful to compare the two systems on the basis of **per hectare farmed or capital invested**. These figures are taken as the non-weighted averages (that is, each farm has equal weight and is not dependent on, for example, area farmed) of the farms included in the study, and not as the total returns to resources divided by the total area farmed or total capital invested. For both measures (rate of return per hectare and per capital invested) the figures are statistically significantly lower on the b-d farms than on the conventional farms.

In light of the fact that there is now a developing market for b-d milk, it is interesting to know how much extra the b-d farmers would have needed to earn per litre of milk in order to obtain the same returns as the conventional farmer neighbours. Obviously, this figure is different for each farmer, so the calculations were carried out on the average figure for the two groups of farmers. For 1989-90 the extra needed for b-d farmers to receive a similar return to resources was 10.4 c/L, in 1990-91 it was 8.9 c/L, and in 1991-92 it was 11.5 c/L. For the last two years approximately 1.0 and 1.5 c/L can be deducted if the marketing arrangements for the conventional farmer (of the New South Wales pair) had been similar to those of the b-d farmer.

It is difficult to know the extent to which the difference in net returns to farming is due to the system of farming, and what is due to other factors. One such other factor is **management skill**. This is a component of farming which is extremely difficult to measure. In this study an approximation was obtained by asking farmers themselves about what they thought about their own management skill and that of their neighbour's. In addition, an officer of the Department of Agriculture was asked to provide an opinion. Combining the different opinions showed that the pairs of farmers were reasonably well matched as far as management skill was concerned apart from one pair, where all three opinions agreed that the conventional farmer was considerably better.

In **summary**, all financial measures (total cash receipts and costs, farm cash operating surplus, returns to capital and management and to resources) are lower for the b-d than for the conventional dairy farmers. It is likely that management skill was not a major contributor to this difference though, in so far that it did influence figures it is likely that it disadvantaged the b-d system in this survey.

4. Summary and Concluding Comments

A comparison of financial costs and returns on bio-dynamic and conventional dairy farms in the Goulburn Murray Irrigation District in Victoria in the years 1989-90 to 1991-92 indicates the following:

- total cash costs (based on the methodology used in the ACIL study) per farm were found to be between 33 and 40 per cent lower on the b-d farms, and costs per litre of milk were 3 to 15 per cent higher. The main differences which can be attributed to management practices were in higher feed costs (mainly fertiliser, agistment and grains) and herd costs (mainly animal health) on conventional farms. Cash cost per litre of milk was not found to be statistically significantly different between the two systems;
- although the total farm area used for dairy purposes is lower on conventional than b-d farms, the total effective dairy area on b-d farms is similar or lower;
- production of milk per cow and per hectare were lower on b-d farms:
- on b-d farms litres per cow varied between 70 and 80 per cent of those on conventional farms. A difference in the proportion of the herd composed of high yielding Friesian cattle influences production per cow. The average percentage of Friesian cattle was 75 per cent on b-d farms, and 90 per cent on the conventional farms;
- litres per hectare were between 30 and 35 per cent lower on b-d than on conventional farms;
- total weeks worked was between 7 and 15 per cent less on b-d farms as compared with on conventional farms;
- lower cash receipts on b-d farms (approximately 60 per cent of conventional farms);
- lower cash cost (based on the methodology used in the ABARE estimates) (between 63 and 76 per cent of conventional farms);
- lower cash operating surplus on b-d farms (approximately 45 per cent of conventional farms);
- lower returns to resources on b-d farms:
per total farm:
- between 0 and 26 per cent of returns on conventional farms;
per effective dairy hectare operated (statistically significant difference):
- between 14 and 28 per cent of returns on conventional farms in 1989-90 and 1991-92, and negative on b-d farms in 1990-91;

per capital invested (statistically significant difference):

- between 17 to 30 per cent of conventional farms in 1989-90 and 1991-92, and negative on b-d farms in 1990-91.

However, in two of the three years, ABARE's averages of the rates of returns to resources in Victoria were similar to those on the b-d farms.

In conclusion, under prevailing input and output prices, **private net returns** to the b-d farmers surveyed were lower than to the conventional farms. Based on the survey results it seems that **productivity** or **output premiums** on b-d farms would have to increase by approximately \$0.10 per litre before b-d farms would be as profitable as their conventionally farming counterparts.

However, the analysis such as the one carried out in this report does not take into account biological efficiency, a topic [Kiley-Worthington and Rendle \(1984\)](#) discuss. This concept, including a '**net yield**', is based on the notion that the prices of purchased inputs, such as fertilisers, fodder and concentrates, do not reflect all, including environmental, costs. In this study, the net milk yield would be the yield adjusted for the following variables:

- the number of hectares used both on the farm and in agistment;
- the amount of soil nutrients, fodder and concentrates (grains) imported on to the farm: on average the b-d farmers in this survey used considerably less of these inputs than the conventionally farming neighbours. The b-d farmers spent little on soil nutrients and feed grains, although feeding grain is allowed under their management system. It would be interesting to see what effect a similar expenditure on concentrates would have on output, and returns, on b-d farms.

Another factor which could change comparative performance significantly are changes in **input prices**. For example, an increase in fertiliser and pesticide prices, to reflect more accurately environmental costs, would reduce the returns to conventional farming relative to b-d farming. Of course, the survey was carried out some time ago in one particular area. Figures may be different now, due to institutional and management changes over the last decade. There may also well be differences due to locality. In other words, dairy farmers who are considering changing towards organic farming should use the data presented here as a guide only. They would be wise to estimate the effect of the change taking into account their particular circumstances, under present conditions of input and output prices.

The figures mentioned in this paper show only the on-farm effects. It is likely that **off-farm costs** associated with bio-dynamic farming are significantly lower than with conventional farming. Off-farm effects of inputs used on farms include aspects such as water quality with its effect on human and livestock health, irrigation, wild-life and other environmental matters; use of non-renewable resources such as phosphorus; and pesticide resistance of weeds.

In a study in The Netherlands, [Berenschot \(1989\)](#) compared a hypothetical situation where all farms were under conventional management with a situation where all were under bio-dynamic management. Although the net private benefits (total benefits minus costs which accrue to the farmer) from bio-dynamic farming were found to be less than from conventional farming, the total net benefits (the net private benefits and the net off-farm benefits) favoured bio-dynamic agriculture.

So, in summary, it may be tempting to conclude from this study that the renewed interest in b-d farming is misplaced, as the financial benefits are not comparable with those of conventional farming. However, some caution needs to be exercised in coming to such a conclusion.

In the first place, although the returns on the conventional farms were considerably higher than on the b-d farms in all three years surveyed, in two of the three years the returns on the b-d farms were similar to those on the average ABARE dairy farms.

Secondly, the sample is very small, so that changes in conditions on one farm may have a major influence on the overall picture, such as the changed marketing arrangements for one pair of farmers. Thirdly, a better measure of the off-farm costs is needed, both for off-farm produced inputs imported onto the dairy farm (such as feed) and the effects of inputs used on the farm (such as fertilisers).

Only when those off-farm costs have been included can a conclusion be derived about the economic benefits of b-d farming for the nation as a whole, rather than for the farmer. An assessment can then be made of whether a 10 cts/L premium on b-d milk, required by these b-d farms to break-even with their neighbours, is realistic to cover the differences in environmental costs involved in the two dairy management systems.

A fourth factor is that, in the last ten years, more experience has been gained in b-d and organic farming, and this is likely to be reflected in their productivity figures. So a more extensive survey, including more dairy farmers under present production and marketing conditions, and an analysis of the environmental costs should be on the top of the list of a prospective CRC.

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Footnotes

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