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## Analysing drought impacts and recovery options by adapting a dairy farming systems modelling approach

Dan Armstrong<sup>1</sup>, C Ho<sup>2</sup>, P Doyle<sup>2</sup>, B Malcolm<sup>3</sup>, I Gibb<sup>4</sup> and S Brown<sup>5</sup>

<sup>1</sup> Department of Primary Industries, RMB 2460, Hazeldean Road, Ellinbank, Victoria 3821

<sup>2</sup> Department of Primary Industries, 120 Cooma Road, Kyabram, Victoria 3620

<sup>3</sup> Institute of Land and Food Resources, University of Melbourne, Parkville, Victoria 3052

<sup>4</sup> Farmanco, 2 Azalea Court, Kyabram, Victoria 3620

<sup>5</sup> Tatura Milk Industries, Tatura, Victoria 3616

[Dan.Armstrong@dpi.vic.gov.au](mailto:Dan.Armstrong@dpi.vic.gov.au)

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**Abstract.** The dairy industry in northern Victoria faced dramatic changes between 2001/02 and 2002/03. Drought resulted in a substantial decrease in availability, and subsequent increase in price, of irrigation water and supplementary feed. Most farms recorded substantial net cash flow deficits. Prior to 2002/03, a project had been established using case studies and a spreadsheet model to examine potential futures for different farm types. This approach was successfully adapted to examine drought impacts and recovery options under the vastly different prevailing circumstances. Several factors appear to have contributed to the adaptability of the approach, as follows:

- The approach considered many aspects of farm management systems, but was simple enough to allow adaptation.
- The project team and steering committee had developed a good understanding of the relationships between components of farming systems, enabling rapid adaptation of their mental frameworks.
- The approach focussed more on helping people question, discuss and learn, rather than providing an absolute answer.

**Keywords:** dairy farming systems, drought, farm management economics

### Introduction

The irrigated dairy industry in northern Victoria and southern NSW faced a dramatic change in operating environment between 2001/02 and 2002/03. A severe drought resulted in a substantial decrease in the availability of irrigation water and supplementary feed, and a subsequent increase in the price of these inputs. The drought also coincided with a decrease in milk prices of approximately 25%. These rapid and dramatic changes in the operating environment increased the complexity and uncertainty in making management decisions during this time.

Understanding the impact of the drought and comparing recovery options was important for both farm management and policy decision-making. Prior to the drought, a case study and spreadsheet model approach had been developed to examine development options for different farm types and farming

systems in a 'Future Farming Systems' project based at DPI Kyabram (Doyle et al. 2002, Ho et al. this edition). The approach to examining development options for different farm types involved considerable inputs from a project steering group representing a range of expertise. The 'Future Farming Systems' approach was adapted to look at the drought impacts and recovery options under the prevailing circumstances, which were very different to those when the approach and model were developed a year earlier.

This work created significant interest amongst the dairy industry and had a number of valuable uses, including being used in the Exceptional Circumstances submissions for dairy farmers in the region.

This paper will describe analysis of drought impacts and recovery options. The key factors that have contributed to making this approach readily adaptable will also be discussed.

## Method

There were several aspects of the 'Future Farming Systems' approach adopted in this project that will be discussed in this section. Further details can be found in Doyle et al. (2002) and Ho et al. (this edition).

### Case studies

A case study approach was used to examine the impacts of drought and recovery options as farm management decisions need to consider the complex combination of human, production, environmental, economic, and financial components of the business (Makeham and Malcolm 1993). This case study approach enabled an in-depth analysis of the impacts of the drought and various recovery options on a small number of businesses.

The analysis of the case study businesses focused mainly on the economic, financial and production aspects. It was not considered feasible to incorporate the human/management aspects into the model, but the involvement of the steering committee ensured these aspects were not ignored.

To examine potential futures for different farm types, Doyle et al. (2002) abstracted from the actual case study farms. This was seen as a compromise between inventing the case study entirely and finding a real, but unique one-off example. By beginning with a real farm, the infrastructure was realistic, but by then using abstraction, there was freedom to remove some of the unique characteristics of the real cases to make it more generally representative. The approach of abstracting from the actual case study farms was also used in examining the impacts of drought and recovery options as it is likely that a larger number of farmers would then relate more closely to the case study.

### Steering committee

Considerable inputs were obtained from a steering group comprised of farmers, consultants, a rural counsellor, a water industry representative, an extension officer, economists and scientists. The project steering group met every three months and provided overall direction on the systems to be analysed, the issues that needed to be considered and communication of the outcomes of the analysis. This ensured the analyses carried out were subject to rigorous questioning, and a broad range of perspectives were considered. The group also provided ownership of the project at a regional level and ensured that the analyses undertaken were aligned with industry needs.

## Model

Excel spreadsheets were used for both the economic and biophysical modelling. The profitability and risks inherent in each system have been assessed by analysing and defining the current farm (before change) as the starting point of the method. The state of the business during and after change was then investigated using whole farm and development budgets over an eight-year planning period. The methods used for farm management economic assessments are described in (Makeham and Malcolm 1993). Both cash and profit analyses were conducted. The approach to risk assessment involved sensitivity testing of milk and feed price scenarios.

### Drought Analysis

The on-farm impact in 2002/03 of prevailing milk prices, supplementary feed costs and water availability and costs has been examined using two case studies, a traditional family farm and a high input farm. The likely performances of these case study farms were then examined under assumed operating environments for 2003/04 and the subsequent five years.

The focus was mainly on the cash-flow issues in the drought analysis, but it was also necessary to consider the impact on equity and the balance sheet.

The analysis was updated as conditions changed and feedback from audiences was incorporated into the approach.

## Results and Discussion

### *Drought Impact and Recovery Options for the Traditional Family Farm System*

#### Case Study Farm Details and Assumptions

- 180 cows
- 55 hectares perennial pasture
- 220 ML water right (4 ML/ha) and no water from other sources
- Situated on the Goulburn Irrigation System
- Grain price: \$180/t in a typical year, \$320 in 2002/03, \$250 in 2003/04
- Hay price: \$120/t in a typical year, \$230 in 2002/03, \$175 in 2003/04
- Milk price: \$7.00/kg butterfat (BF) in a typical year, \$6.00 in 2002/03, \$6.50 in 2003/04
- It was assumed there was no change in per cow production in 2002/03 or subsequent years.
- Pasture production in 2003/04, from pasture dried off in 2002/03, was 80% of that prior to drying off (pasture consumption decreased from 10 to 8 t DM/ha). The pasture consumption from

these pastures in subsequent years was 100% of that prior to drying off.

- Personal drawings of \$40,000 each year were assumed.
- To isolate the impact of the dry season, it was assumed the farm had no initial debt.
- Any grants, income support or interest subsidies have been ignored. Hence, the impact will be lower in many cases than the figures in Table 1 (see Appendix) suggest.

In years of typical prices, costs and resource availability, this farm is a viable enterprise with a Net Cash Flow (NCF) of approximately \$75,000. However, consistent periods of typical conditions are unusual and applying the actual conditions for 2002/03 has a significant impact on the NCF.

Options for 2002/03 Strategies that could have been implemented to manage the drought and some recovery options were analysed (Table 1, see Appendix).

- Cull 15% of the herd – reduce herd size to 153 cows in 2002/03 and return to 180 cows in 2003/04.
- Cull 40% of the herd and purchase all replacements in 2003/04.
- Cull 40% of the herd and gradually rear replacements over four years to replace stock.
- Park all cows and bring them back in 2003/04 ('parking' cows involves leasing the cows to another farm for no cost). For simplicity, it was assumed that all cows were sent off farm after calving and no milk income would be received.

The impact of the drought and time to break-even, where the 'cull 15%' option was implemented, is shown in Figure 1 (see Appendix).

The 2002/03 season's circumstances have had a significant impact on farms of this type. The best option for 2002/03 varied from farm to farm, but generally less cows at home led to the lowest increase in debt.

The large difference in peak debt between the 'cull 40%, purchase replacements' and 'cull 40%, rear replacements' suggests that purchasing replacements in 2003/04 was unlikely to be a good option. It also indicated that running a lower stocking rate in 2003/04 was likely to be an advantage as feed costs were likely to be relatively high (at least for the first six months) and milk price was unlikely to be high.

The time to break-even was sensitive to the irrigation water allocation and supplementary feed prices in 2003/04 and also to milk price.

Development options, such as expansion, would have been good investments for the traditional family farm case study in typical circumstances (Doyle et al. 2002). However, these development options, which required increased debt, have been hit extremely hard as a result of the operating environment in 2002/03 (Ho et al. 2003). A higher initial debt resulted in a higher peak debt and extended the time to break-even.

### ***Drought Impact and Recovery Options for the High Input System***

The drought analysis for the high input farming system has been separated into two streams, depending on whether the farm was a domestic market supplier or export market supplier.

#### Case Study Farm Details and Assumptions

- 550 cows
- 96 ha perennial pasture
- 508 ML water right (5 ML/ha), 250 ML groundwater
- Situated on the Goulburn Irrigation System
- Grain price: \$180/t in a typical year, \$320 in 2002/03, \$250 in 2003/04
- Hay price: \$120/t in a typical year, \$230 in 2002/03, \$175 in 2003/04
- Milk price: Domestic supplier – \$7.50/kg BF. Export supplier – \$7.00/kg BF in a typical year, \$6.00 2002/03, and \$6.50 in 2003/04
- Assumed no change in per cow production in 2002/03, except where specified.
- Pasture consumption in 2003/04, from pasture dried off in 2002/03, was 80% of that prior to drying off (pasture consumption decreased from 11.2 to 9 t DM/ha). The pasture consumption from these pastures in subsequent years was 100% of that prior to drying off.
- Assumed personal drawings of \$60,000 per year.

To isolate the impact of the dry season, it was assumed there was no initial debt.

Any grants, income support or interest subsidies have been ignored. Hence, the impact will be lower in many cases than the data in Tables 2 and 3 suggest.

If typical operating conditions had occurred in 2002/03, the export and domestic supplier would be expected to record NCFs of \$199,500 and \$276,500, respectively.

Domestic market supplier For the domestic market supplier, the system is unlikely to change significantly during the drought year, due to contractual requirements and a more

stable milk price. Two options were analysed (Table 2, see Appendix):

- No change to the system, but purchase more feed.
- Cull 15% of the herd – reduce herd to 468 in 2002/03 and return to 550 in 2003/04.

Export market supplier. For the export market supplier, the options tested were not vastly different from those of the domestic market supplier. Discussions with farmers in this situation indicated that other options, such as, parking all the cows, were given some passing consideration. However, they were rarely considered seriously, as it would be difficult to find a farm that would take such a large herd. Relinquishing current staff and then finding suitable replacements would also be an issue. Options tested for this system were:

- No change to the system, but purchase more feed,
- No change to herd size, but decrease per cow production by 10%, and
- Cull 15% of the herd – reduce herd to 468 in 2002/03 and return to 550 in 2003/04.

Applying the actual operating conditions for 2002/03 had a significant impact on the NCF of the high input systems, particularly those supplying the export market. From the preliminary analysis, this high input system was able to recover from the impacts of the dry season in a few years if the milk price was as high as that assumed for a domestic market supplier.

Without this price, it appeared that a high input farm, supplying the export market would have difficulty recovering from losses incurred during the drought year, within the analysis period (Table 3, see Appendix). All three options result in slightly different impacts on NCF. However, they are similar in that significant action needs to take place to facilitate recovery. In these circumstances it is reasonable to assume a business manager would restructure the farm system and business during and/or after the drought year.

A longer-term recovery strategy for the export supplier was also tested. By increasing the amount of pasture consumed per hectare, decreasing the need for bought in supplements and by-products, reducing stock numbers in the years following the drought and increasing milk production per cow, it appeared that the export oriented supplier could recover and break-even. A number of assumptions were made in the analysis of this strategy, but are within the

realms of what is being achieved on some farms.

### ***In hindsight, how good was the modelling?***

Tactical management decisions, grants, income support, interest subsidies, off-farm income and reduced personal expenditure enabled many farmers to record less substantial NCF deficits in 2002/03 than predicted by the modelling. However, the 2002/03 season did have a significant impact on dairy farm businesses as illustrated by the amount of restructuring that has occurred since. Dairy farm numbers in the Northern Irrigation Region of Victoria have declined from 2449 in 2001 to 2027 in 2003 (Goulburn Murray Mastitis Advisory Group unpublished data). Many of the farm businesses remaining in the industry have undergone, or considered, significant alterations.

While the modelling suggested that high input systems were more likely to have larger NCF deficits, this was not always the case. Timing (and quality) of decision making also appeared to have a significant impact (Gibb 2003). Some farmers running high input systems recorded relatively low NCF deficits. This does not necessarily mean their systems were lower risk. It appears that more proactive and skilful decision-making reduced the impact of the drought. Conversely, some low input farmers experienced relatively high NCF deficits. This appears to be related to a lack of skills to assess options and act quickly in a rapidly changing environment, rather than inherent risks in their farm system

The assumptions used in the modelling resulted in NCF predictions for 2003/04 that were a relatively good indication of what actually occurred. However, for the five years following 2003/04 the analysis used the same milk price and supplementary feed price. These prices are likely to fluctuate markedly between years and the analysis of risks would be improved if the modelling incorporated some price fluctuations and did not use an average price for all years subsequent to the drought.

### ***Key factors associated with adaptability of the approach***

To provide assistance to farmers making decisions during 2002/03, rapid and continuing adaptation of the 'Future Farming Systems' approach was crucial. A feature of the operating environment in 2002/03 was the ongoing change to water availability and price, brought in feed costs, and milk price. Analysis of the impact of the drought and recovery options was conducted for two different systems in a relatively short space of time. Several factors, which appear to have contributed to making this approach

readily adaptable, are discussed in this section.

The 'Future Farming Systems' approach considered many aspects of farm management systems, but the aim was to keep it relatively simple while providing meaningful direction. If the approach had attempted to simulate the complexity of the system in a sophisticated and detailed manner it would have been extremely difficult to adapt the model and use it to respond to changes in the operating environment.

The approach of using a representative case study for each farming system meant that information that was generally useful to most farms could be generated without accounting for all the diversity present on individual farms. The approach focussed more on helping people question, discuss, learn and think through the issues, rather than providing an absolute answer. Generally trends, principles and relationships between variables were discussed and it was acknowledged that 'passing the test of common sense' is often more important than being extremely accurate.

The diverse range of options that were adopted, in response to the drought in 2002/03, highlighted the importance of acknowledging that a variety of options were likely to be suitable. Individual circumstances varied markedly, and presenting a single answer was not appropriate.

One of the most valuable resources developed in the first phase of the project was the capacity of the project team and steering committee. The project team and steering committee developed a good understanding of the relationships between the main components of farming systems, enabling rapid adaptation of their mental frameworks. This was important, as the majority of dairy farmers in this region had never before been required to deal with such a low irrigation water allocation and the associated impact of rapidly changing input costs.

Developers of models often acquire significant learning (McGill 2001, McCown 2002), thus by involving the steering committee in the development of the model the learning was shared amongst a larger group of people.

### Conclusions

The 2002/03 season has had a significant impact on dairy farm businesses on the Goulburn Irrigation System. While there are several factors that enabled some farms to achieve lower NCF deficits than the modelling predicted, it was still likely to take several

years to break-even from the losses incurred on the majority of farms.

Modelling suggested that large farms running high input systems were likely to have larger NCF deficits than smaller farms running lower input systems. However, the timing and quality of decision-making may have had a greater impact on NCF than the farm system.

The 'Future Farming Systems' approach appears to have been adapted successfully in this complex and rapidly changing situation. Several factors appear to have contributed to making this approach readily adaptable.

The approach considered many aspects of farm management systems, but was simple enough to allow the spreadsheets to be readily adapted as circumstances changed.

The project team and steering committee had developed a good understanding of the relationships between components of farming systems, enabling rapid adaptation of their mental frameworks.

The approach focussed more on helping people question, discuss, learn and think through the issues, rather than providing an absolute answer.

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**Appendix**

Table 1: Summary of peak debt and time to break-even for the various options for the traditional family farm.

Options	Peak debt	Years to break-even*
Cull 15%	-\$218,600	4 (2006/07)
Cull 40%, purchase replacements	-\$272,100	5 (2007/08)
Cull 40%, rear replacements	-\$167,700	3 (2005/06)
Park all	-\$111,700	3 (2005/06)

\* Year when cumulative NCF becomes positive

Table 2: Summary of peak debt and time to break-even for various options on the high input farm supplying the domestic market

Options	Peak debt	Years to break-even*
No change, but purchase more feed	-\$497,200	4 (2006/07)
Cull 15%	-\$412,500	3 (2005/06)

\* Year when cumulative NCF becomes positive

Table 3: Summary of peak debt and time to break-even for various options on the high input farm supplying the export market

Options	Peak debt	Years to break-even*
No change, but purchase more feed	-\$753,100	Over 5 (beyond 2008/09)
Decrease per cow production by 10%	-\$679,900	Over 5 (beyond 2008/09)
Cull 15%	-\$636,600	Over 5 (beyond 2008/09)

\* Year when cumulative NCF becomes positive

Figure 1: Net cash flow over an 8-year period for the traditional family farm where the 'cull 15%' option was implemented.

