SHOW ME THE PROFIT!

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Take home messages

- **Farm profit is made up of cash, efficiency of resource use and wealth**
- **Marginal analysis looks at the extra output for each unit of input**
- **All input/output relationships are curvilinear with diminishing returns**
- **Responses should be based on marginal not average values**
- **Partial budgets are a formal way of committing marginal analyses to paper. It is called partial because it only considers parts of the system that are likely to change**

Every farming system is unique

Each farming system is a unique mix of farmer goals, skills, experiences and attitudes to risk and opportunity as well as a different resource base. Age, stage of life, equity level and debt also play a part. The operation of dairy farming systems is also extremely complex. There are a multitude of variables that have to be dealt with on a daily, seasonal and annual basis. These include pasture types, calving dates, irrigation issues, genetics, supplementary feeding levels, etc. The list goes on and on in Table 1.

Table 1. The diagram below provides some idea of the potential diversity of systems

System 1	System 2	System 3
red tractor	blue tractor	green tractors
yellow cows	XB cows	B&W cows
500 kg MS/cow	280 kg Fat/cow	10,000 litres/cow
450 kg cows	550 kg cows	700 kg cows
1.0 t grain/cow	1.5 t grain/cow	2.5 t grain/cow
spring calving	split calving	year-round calving
perennial pasture	perennial/annual pasture	feedlot

Given this complex mixture of managers, resources and options, the idea that there might be one single management system that is superior to all others is nonsense. *Provided the size is adequate, virtually all dairy-farming systems can be profitable if in the right hands and managed well.*

'Drivers of profit' and 'Key performance indicators'

Various systems of 'benchmarking' and 'comparative analysis' have been in and out of favour as a means of comparing farming systems. They usually compare technical ratios and call these 'Drivers of profit' or 'Key performance indicators'. A glance at Table 1 will show that the notion that there would be technical ratios that are not only common to all systems but also useful as indicators of business performance across all systems is also nonsense. For example, litres per cow is an important ratio for a feedlot (limited cow spaces) with a contract that pays for milk in litres, but is at best meaningless and at worst a negative indicator for a pasture-based seasonal calving

herd that is paid in the standard form Protein + Butterfat - Volume. Technical ratios (production/cow, pasture consumed/ha, etc.) do not drive profit or indicate performance, they are descriptors of systems. ***The only common link between all farming systems is profit.***

What do we mean by profit?

The term 'profit' clearly means different things to different people. Farmers, accountants and nutritionists all have their own versions. The farm management economist's definition of profit includes three elements: cash, efficiency and wealth.

- **Cash** – is the business generating enough cash to pay the bills, repay loans and reward me for the work?
- **Efficiency** – how efficiently are the resources I am using employed? (operating profit, net profit, RoC)
- **Wealth –** do I own more than I did a year ago? (This equals any operating profit not used for interest, consumption or tax)

How do we go about measuring profit?

There are many different terms that are used to describe the three elements of profit. They include:

- Earnings before interest and tax (EBIT)
- Return on total capital invested (RoC)
- Return on equity (RoE)
- Net Cash Flow
- Debt servicing ability
- Equity
- Equity % and others

There is no one single measure that adequately describes overall business performance. We need to use a range of these measures.

Operating Surplus (OS = cash farm income less cash operating costs; herd, shed, feed, overheads) is another term that is commonly quoted in business analysis. It is a mixed measure (part cash, part equity). It is not a measure of profit in itself but is a useful starting point to use when calculating these other measures of profit.

'Taking Stock' – useful background data

Most farmers will be aware of the program developed by Dairy Australia (DA) for the dairy industry called 'Taking Stock' (TS). It has been well supported by manufacturers and well patronised by farmers. What TS does is summarise physical and financial data for a farm business, including the cash position and balance sheet. It also calculates measures of physical performance.

When DA evaluated TS as a tool for the industry, the most common comment from farmers was along the lines of, "TS has provided me with a measure of the performance of my business. What I want now is to know how to make my business more profitable."

From 'Taking Stock' to profit

In its current form 'Taking Stock' does not provide all of the information required to calculate business profit although DA is working to remedy this. 'Taking Stock' provides a balance sheet (wealth) and a range of technical analyses but currently only takes us as far as Operating Surplus (OS) in terms of cash. To get from OS to measures of profit we need to throw in operator allowance, changes in inventory and depreciation. All three extra pieces of information require some explanation:

- **Operator allowance** is an estimate of what you would have to pay someone to do what you do for the business. It is not your drawings or salary. As a rough guide we use $400 per cow less paid labour. What you use as an operator allowance is up to you.
- **Changes in inventory** include using livestock profit rather than stock sales and making allowance for changes in stocks on hand (eg. hay, grain, and silage).
- **Depreciation** of plant and machinery is a real cost. We could use the difference in value at the beginning and end of a period or we can simply use a standard figure like 20% of machinery value as an estimate.

Even with all of this extra information, TS (or any other data collection program) is unable to answer the question, "How can I make my business more profitable?" All data collection programs (including TS) use historical data. In effect this tells us how profitable a business was. The use of the past tense, 'was', is critical. Knowing how much profit (or how big a loss) we made in the past does not tell us how to become more profitable. Comparing notes with other farmers will not answer this question either. What we actually need is a different set of tools. These tools include marginal thinking/analysis and partial budgets.

How to improve profit?

Marginal thinking and marginal analysis

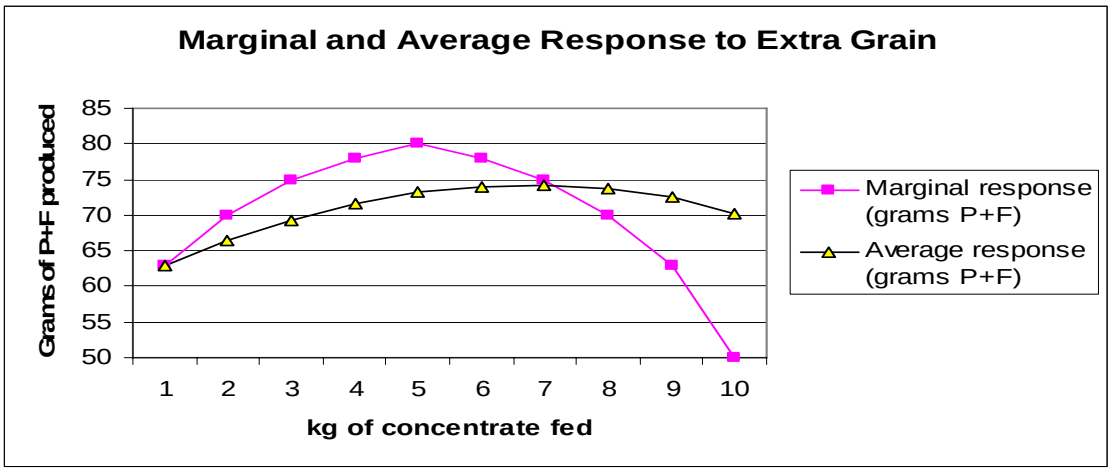
Marginal analysis looks at the extra output for each extra unit of input. In effect it asks the question, "What will change if I add or subtract one unit of input?" This is what we call the marginal response. Arriving at this figure requires thinking a little differently about responses. The marginal response is the extra output for the last unit of input. This can be calculated for all sorts of elements of a farming system, for example, fertiliser, supplement levels, herd size, labour, land, water, etc. It is possible to calculate a marginal response for any unit of input.

The critical understanding behind marginal analysis is that the principle of diminishing returns applies to all aspects of farming systems (and most aspects of life). This principle says that the extra output produced by adding extra units of input will eventually decrease as more units are added. At some point is may even become negative (add another unit, produce less total output) although it is unusual for inputs to be pushed this far (eg. adding an extra cow without extra feed inputs when a farm is already fully stocked).

The values obtained by marginal analysis are quite different from the numbers that come out of 'benchmarking' or any other form of retrospective analysis. By definition these have to be average values as they are calculated from total output divided by total input (eg. cows/ha, litres/cow, etc.).

The very important difference between marginal and average responses is best illustrated in Figure 1.

Figure 1. Marginal and average response to extra grain input for a herd grazing paspalum-based pasture.



This graph comes from work at Kyabram. It is an example, not a universal curve that can be applied to all situations. A different herd of cows, different pastures or a different time of year would produce a different marginal response curve.

This graph shows both the average output of Milk Solids (yellow triangles) and marginal output (purple squares).

- Average output is extra output above no grain divided by total kg of grain fed. Notice how it peaks at about 75 g P+F at about 7 kg of grain and then starts to fall slowly. Even at 10 kg of grain the average response is still 70 g MS/kg.
- The marginal curve on the other hand peaks at 80 g/kg at 5 kg of grain. Both the 4th and the 6th kg of grain result in a lower response than the 5th. By the 10th kg, marginal response has fallen to 50 g MS.

The marginal response curve is much more useful than the average response curve as it tells us that at anything less than 5 kg we are feeding too little while above 8, 9, or 10 kg (depending on where the break-even response is) we might be feeding too much. We cannot get this information from the average response curve.

Nutritionists who provide advice to farmers often quote average responses and even worse, sometimes imply that production responses are linear (ie. no diminishing returns). It has also become fashionable to talk about production responses in litres (1 litre/kg of grain). This compounds the first two errors because the vast majority of farmers are paid on the basis of Protein + Butterfat - Volume. Extra litres without extra MS means less income, not more.

The eventual result of this advice is likely to be:

- Production of milk of lower composition as a result of chasing volume. This will result in extra production costs for farmers and extra processing costs for manufacturers (leading eventually to lower milk prices).
- Feeding at uneconomic levels (extra milk income not enough to cover extra feed costs) and a reduction in profit for the business

- Increased exposure and risk for the farmer when milk prices and feed costs fluctuate and margins are squeezed

There is evidence of all of these trends in the dairy industry over recent years.

The level of supplementary feeding is only one example of how marginal thinking can be applied to make farm businesses more profitable (or resist them becoming less profitable). Commercial businesses selling feed, fertiliser, seed and semen have a vested interest in selling as much product as possible. Farmers need skills in marginal thinking and marginal analysis to strike the right balance on inputs and to increase profit.

There are various 'black box' type programs available that claim to be able to predict increases in profit as the result of a change of management. Most of these rely on average response data and even worse, many assume linear responses. In most cases the predictions they produce will be wrong.

We do not need to spend vast amounts of money on new research to make marginal data available to the dairy industry. A lot of the research that has already been done and paid for on most aspects of production systems could be re-interpreted to provide a set of marginal response curves for a range of inputs to the dairy industry.

Partial budgets

A partial budget is a formal way of committing marginal analysis to paper. It is called 'partial' because it only considers parts of the system that are likely to change. The basic layout includes GAINS (extra income/reduced costs) and LOSSES (extra costs/reduced income). The trick is to think through the changes that will occur when adding or subtracting the last unit. The thinking behind partial budgeting is best illustrated by the following example.

Adding an extra cow to the herd.

GAINS **(extra income/reduced costs)**	**LOSSES** **(extra costs/reduced income)**
Extra milk income Extra stock income	Extra herd costs Extra shed costs Extra feed costs Extra labour

We can get background information from a program like TS.

Table 2. An example of average income and cost data for a farm expressed on a per cow basis.

	Current herd average (from benchmarking)	
Extra income		
Milk		$2,000
Stock		$100
Total extra income		**$2,100**
Extra costs		
Herd		$100
Shed		$70
Feed - grain	1.5 t @ $300/t	$450
- hay	1.0 t @ $180/t	$180
Labour		$150
Total extra costs		**$950**
Net gain (extra income - extra costs)		**$1,150**

The figures we have shown in Table 2 are actually average values. For example, milk income per cow is total milk income divided by the total number of cows in the herd. These average values may not be the right values to use if the next cow we add does not incur average costs or earn average income.

Table 3. Average income and cost data for a farm expressed on a per cow basis compared to marginal income and cost data in an understocked situation.

	Current herd average (from benchmarking)			Values used for marginal analysis	
Extra income					
Milk		$2,000			$2,000
Stock		$100			$100
Total extra income		**$2,100**			**$2,100**
Extra costs				**understocked**	
Herd		$100			$100
Shed		$70			$40
Feed - grain	1.5 t @ $300/t	$450		1.5 t @ $300/t	$450
- hay	1.0 t @ $180/t	$180		1.0 t @ $180/t	$180
Labour		$150			$0
Total extra costs		**$950**			**$770**
Net gain (extra income - extra costs)		**$1,150**			**$1,330**

For example:

- Milk and stock income might be average for the next cow added
- Herd costs (AI, herd test, vet, drenches) are also likely to be average
- Shed costs might be less than average as we are unlikely to use much more detergent or rubberware for an extra cow but will use extra electricity
- If the farm is understocked, extra cash costs for feed might also be average.
- We might decide that there would be no extra labour cost if we added an extra cow. This is not entirely logical however as it implies that we are willing to work harder for no extra reward.

On the basis of these assumptions, the partial budget is saying that adding an extra cow will produce a net benefit of $1,330 after allowing for extra costs. If we could buy cows for say $1,200/head this represents a return to extra capital of 111%. We would pay for the extra cow in less than a year. Buying extra cows would be a very good business decision.

If however, the farm happened to be fully stocked already our partial budget would give us an entirely different result.

Table 4. Average income and cost data for a farm expressed on a per cow basis compared to marginal income and cost data in a fully stocked situation.

	Current herd average (from benchmarking)			Values used for marginal analysis	
Extra income					
Milk		$2,000			$2,000
Stock		$100			$100
Total extra income		**$2,100**			**$2,100**
Extra costs				**fully stocked**	
Herd		$100			$100
Shed		$70			$40
Feed - grain	1.5 t @ $300/t	$450		4.0 t @ $300/t	$1,200
- hay	1.0 t @ $180/t	$180		2.0 t @ $180/t	$360
Labour		$150			$400
Total extra costs		**$950**			**$2,100**
Net gain (extra income - extra costs)		**$1,150**			**$0**

For this example we have assumed that we want a commercial return for working harder and have included $400 per cow for extra labour. The main difference though is in feed costs. If the farm were already fully stocked (that is, the existing herd were eating all the pasture grown) we would need to supply all of the feed for the extra cow as supplements. If this cow ate 6.0 t of dry matter per year (about right for a 600kg cow producing 500 kg of MS) and our feed costs were as assumed, there would be no margin as a result of milking an extra cow and therefore no return on extra capital. In this case adding an extra cow would be a poor business decision. We might even think about getting rid of some cows that were producing less than herd average.

It is quite clear that the extra feed cost is the critical issue in this example. The results would also be different with supplementary feed at different prices and milk at different prices. We could actually use this partial budget to test just how sensitive the bottom line is to changes in milk price and feed costs. This is called sensitivity analysis. It is a very useful way to test risk.

The point of this partial budget exercise is that it demonstrates how marginal thinking can help to make informed decisions about the future direction of a business.

- Had we relied on average values (or benchmark values) to make a decision on herd size we would keep on adding cows assuming that each one earned us an extra $1,150 net of input costs.
- Had the farm been understocked adding cows would, by accident, have turned out to be a good business decision.

- However, had the farm already been fully stocked we would have been working harder for no extra reward and with increased risk (more vulnerable to fluctuations in milk price and grain cost).

A lot less dairy farm businesses are in the equivalent of an 'understocked' situation in terms of inputs like cows, supplements, fertiliser, etc. than 20 years ago. Back then the 'more is better' approach to economics was more likely to be right. Farmers have had to become increasingly efficient just to survive and have pushed inputs up as part of their strategy. Making good business decisions about levels of inputs is more difficult and more important than it has ever been.

Measuring the elements of profit each year and the use of tools like marginal analysis and partial budgets to improve decision making will make it easier for farmers to remain competitive and become more profitable in the future.

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Bill has published widely on agricultural management economics with a particular emphasis on management economics in the dairy industry. He is frequently involved in industry strategic planning, research prioritisation and benefit cost analysis of dairy research investments.