Agribusiness Perspectives Papers 1999

Paper 31
ISSN 2209-6612

Sense and Nonsense in Dairy Farm Management Economic Analysis

Alexandria Ferris and Bill Malcolm
Department of Food Science and Agribusiness
Institute of Land and Food Resources
University of Melbourne
Parkville Victoria 3052
Phone: (03) 9344-0233 or (03) 9344-5015
Fax: (03) 9344-4665
Email: a.ferris@landfood.unimelb.edu.au
b.malcolm@landfood.unimelb.edu.au

Figures

Tables

Abstract

The standard analytical approaches and methods of farm management economics are simple, sensible and powerful. Still, examples of inappropriate nonsensical, approaches to farm management economics questions proliferate. In this paper, the focus is on some inappropriate, nonsensical, approaches to so-called management analysis of dairy farming operations. Included in the analytical eccentricities which abound are such things as trying to evaluate farm performance and changes but not distinguishing between cash (financial feasibility) and profit (economic efficiency), nor considering the time value of earning of capital invested; trying to estimate the cost of pasture; trying to show to lift productivity on one family farm by having a good hard look at the average performance of other farms; and the folly of inventing measures of performance such as Economic Farm Surplus, that are designed and adjusted to facilitate comparisons between farms, and then trying to use such measures for something mostly different, farm management analysis. It is as easy to get it right as it is to get it wrong; so more sense and less non-sense is the call.

Introduction

Agriculturalists who bring to bear on agricultural questions the appropriate balance of relevant disciplinary knowledge, the appropriate perspective, sound technical and economic logic, and weigh up the human and unmeasurable factors, as best they can, are able to provide more valuable advice about farm management than agriculturalists who do not do these things. Technologists who provide good technical advice but who ignore, or mis-apply, economic ways of thinking about agricultural businesses - or worse, make up their own economic 'theory' are reducing the value of the agricultural management services they are attempting to provide.

The focus of this paper is on the proliferation of inappropriate, even nonsensical, analyses of questions to do with dairy farm management economics. Numerous recent examples abound where, having discovered that good technology and technological analysis are necessary but not sufficient conditions for sound farm management decision-making, technologists have turned their hand to farm management economics - sometimes with more non-sense than sense.

In the rest of this paper examples of dairy farm management economic analyses are investigated, errors are identified, and more sound, more appropriate, methods of analysing the questions at hand are presented.

Investigating dairy farm intensification

The first example explored in this paper represents an inappropriate method and approach to the question of farm intensification. The case is the evaluation of the ABC dairy farmlet trial at Ellinbank in Gippsland. In 1992 at the Ellinbank Dairy Institute in Victoria, three 9.3 hectare (later 9.7 ha.) farmlets, designated Farms A, B and C, were established in Gippsland to test out technical and economic aspects of managing dairy farms at three different levels of intensity. Farm A is described as an average farm with typical stocking rate, typical fertiliser applications, and low levels of grain being fed. Replacement stock are raised on the farmlet.

This farmlet runs 14 cows at 1.4 cows per hectare, and production is expected to be about 245 kilograms of milk fat per hectare. The farmlet has 11 paddocks. Farmlet B has a higher stocking rate stocking at 24 cows (or 2.5 cows per hectare); higher than usual fertiliser applications; grain being fed at higher levels than usual. On farmlet B there is more emphasis put on rotations with 22 paddocks being used. Young stock are reared on farmlet B. Farmlet C is the most intensive of the three farmlets. There are 41 cows run at 4.1 cows/ha; a summer crop is grown; tight calving patterns followed and grazing rotations are managed to maximise feed supply. On this farmlet double the fertiliser is used compared to Farmlet A, and more nitrogen is used than in Farmlet B. Grain is fed when it is needed. Young stock are reared off the farmlet.

After three years this research project had generated much technical information - but profitability or financial viability of each option had not been analysed. Therefore the committee which runs the ABC farm program engaged a consultant to 'develop whole farm scenarios for each farm option and document the inputs and outputs, productivity measures, cash flow and profitability of each farm operation. A comparison of the A, B and C farms as whole farms could then be made.

In the ensuing attempt to evaluate the options represented by the farmlet trials, the farmlets were redefined as average sized, 97 ha commercial dairy farm operations representative of the local area. Industry data was used for overhead costs, and the actual physical inputs and outputs of each 9.7 hectare farmlet were multiplied by ten. In the whole farm profit and cash flow analysis, Farm A represents a typical dryland dairy farm in Gippsland, on which 136 cows are milked, which has not undergone substantial development, and has a 12 unit swing over dairy. Typically a male and a female partnership would run such a farm and would get paid $37,000 per annum, with a minimum of paid labour. Land and improvements would be valued at $8,000 per hectare and there would be around $50,000 worth of plant and equipment. Debt would be $155,000 and equity percentage around 80 per cent of total capital.

Farm B is more developed than Farm A, and it would run 242 cows. In the analysis, to convert a Farm A type operation to Farm B type operation, investment in a 25-unit swing over dairy and a larger vat are needed. In all, an extra $310,000 above the requirements of Farm A has to be invested on infrastructure. Compared to Farm A, Farm B has extra livestock that is valued at $75,200. Total value of plant and machinery relative to Farm A has been increased by $40,000. Labour and management requirements of Farm B are an operator and partner who earn $37,000 per annum; and one full time labour unit who earns around $26,000 per annum. Farm B has a total debt of around $500,000 and equity percentage of 57 per cent of total capital. By most standards in Australian agriculture, even including dairying, this gearing ratio is very high - good luck would need to be with you.

Farm C is a heavily stocked 97-hectare farm running 427 cows at 4.1 cows per hectare. Relative to Farm A, an extra $523,000 on infrastructure is involved, including a $300,000 rotary dairy and a large vat worth $90,000. The extra livestock are valued at $212,800. Relative to Farm A, an extra $62,000 of plant and machinery is involved. As well as the operator and partner who get $37,000 per annum, paid labour has been increased in proportion to cow numbers. Farm C total debt is $954,815, giving an equity percentage of 45 per cent of total capital. (See above observation on Farm B gearing!)

In analysing the performance of these farms, the annual net cash flows of the first three years of operation of the hypothetical farms A, B, an C were estimated. The annual net cash flows were then adjusted for imputed costs to give a measure called Economic Farm Surplus (the usefulness of this term will be discussed further in a later section of the paper). Balance sheets are also constructed.

In the above-mentioned attempt to estimate the whole farm profitability and cash position of a low-intensity 97 ha. Farm A, a more developed high-production/cow 97 ha Farm B, and a highly developed high-input, high-output 97 ha Farm C, annual returns to capital and net cumulative cash flows were estimated for the three years that the farmlets had been operating. In Table 1 is a summary of physical and economic performance as estimated in the analysis that was carried out for the committee in charge of the trial. For each farm, A, B, and C, gross margin per cow and per hectare were estimated, overhead costs were estimated, and annual cash operating surplus, imputed costs, economic farm surplus, and three annual rates of return on capital, were also estimated. Cumulative net cash flows were also calculated for the three years for which there was data for each of the three farms - with Farm A accumulating $230,000, Farm B accumulating $50,000 and Farm C accumulating negative $33,000 net cash flow.

From this analysis, the conclusion was drawn:

The extrapolation of the ABC farmlets to whole Farm A B C's has indicated that the potential profitability (measured by Economic Farm Surplus) of a Farm C type is substantially in excess of Farms B and A. This project has indicated that unless carefully planned and constantly monitored the extra production and income generated by an increased stocking rate can be offset by increased expenditure so there is no net gain. There is currently substantial scepticism as to the economic benefits of an expanded system. If the ABC Farmlets are to achieve their maximum impact it is imperative to identify Farm C type farming operations in Dryland Victoria and assess their farm performance to validate if there are real Farms B or C in the Dairyfarm population. The expansion paths of these farms could then be clearly documented and the critical success factors of the case study operators identified. Unless the final step of identifying and evaluating real life Farms B and C is undertaken then the impact of the ABC Farmlets will be significantly reduced.

From the viewpoint of traditional farm management economic analysis grounded in economic theory, there are problems with the analysis that was carried out. In management economic analysis, the approach used is largely determined by the question being asked. In this case, the perspective adopted was to attempt to investigate the profitability of the total investment. That is, the perspective of the analysis which was carried out seems to have been 'If someone was to go and invest in a 97 ha dairy farm, which would be the most profitable farming system?'. The alternative situation is 'I am running an operation of a particular size, for example Farm A, and the business is under pressure to increase productivity to maintain profitability'. In this situation, where the initial investment has been made and the concern is to increase productivity, the appropriate method to use should be marginal analysis - using partial budgeting not whole farm budgeting.

Table 1 - ABC Whole Farm Physical and Economic Summary

Limitations to the analysis of the farmlet trial include:

- Using discrete whole farm perspective instead of a marginal ('add on' to Farm A) perspective.
- Failure to analyse the investment over the expected life of the investment.

As significant capital investment is involved in the first year for Farms B and C - capital that can be expected to contribute to productivity for up to 15 to 25 years - estimating the annual returns to capital and net cash flows for the first three years does not capture fully the profit or cash implications of the investments whose life extends beyond the three years used in the analysis

The annual returns on capital were estimated for each of the three years of operation for each farm, with extra annual depreciation associated with extra plant and machinery adjusted, and with addition to total capital value of new infrastructure capital being valued at 50 per cent from year 1. In the analysis, annual depreciation of the new capital on infrastructure does not seem to have been included, and the starting adjusted capital value used throughout.

Changes in livestock value are attributed to changes in livestock numbers using standard values, though no livestock reconciliation and trading schedule is obvious. However derived, Farm A has an annual trading loss on livestock, Farm B has a trading loss then a trading profit then a trading loss, and Farm C has significant trading losses on livestock. Without a livestock reconciliation and trading schedule it is impossible to know from where these trading profits and losses derive

Capital investments in fertiliser seem to have been included in the activity gross margins.

It is claimed that in moving from a Farm A to Farm C state of development, total net worth might eventually be $1.6m, compared to $996,500 with Farm A. It is not clear what dollar terms are being used (nominal or real), but more importantly, relative riskiness does not get a guernsey - the principle of increasing risk has not been repeated and there are different probitabilities associated with Farm operations A and C having zero net worth too!

More useful ways to assess the profitability and financial feasibility of farm businesses are well established in the farm management economics literature, and in practice. In the case at hand, the comparison is between investment in a relatively low-input, low-output operation and the alternatives of investing in other more intensive operations. If the investments are discrete whole farm alternatives a standard farm management approach to evaluating profitability, financial feasibility and net worth effects of the investments in question is to establish balance sheets at the start; then calculate expected annual net cash flows of the investments for the relevant planning period, then calculate expected Net Present Values (NPV) at the required rate of return and the Internal Rate of Return of the investments, and construct expected balance sheets at the end for each option.

As capital investment is involved to develop the Farms B and C, the full effects of the contribution of this capital is best assessed using the expected net present value of the stream of net cash flows associated with the capital invested in each of the whole farm operations. This needs to be done over a planning period in which the productivity over time from this capital has a chance to be expressed, and which is a time period that is consistent with the types of planning horizon the potential investor could reasonably be expected to contemplate. Depreciation of capital is captured using realistic expected salvage values at the end of the project-planning period. The NPV of each investment is estimated and compared, for a range of required rates of return (discount rates), and for a range of yield and price scenarios, such as worst, poor, most likely, good and best. The economic analysis can be in either real or nominal terms.

Once the likely profitability of the investments in Farm A, B and C has been estimated, then nominal net cash flow budgets are done to assess the financial feasibility of the investments, again over a planning period which is consistent with investors aims and with the earning capacity of the capital involved and again for the above-mentioned range of scenarios plus some scenarios for alternative financing options. The analysis of financial feasibility for whatever level of initial equity capital and borrowing is involved reveals expected peak debt, cash balance at end of planning period, and sensitivity of debt-servicing ability to variability of key parameters. As well, balance sheets at start and end of the planning period indicate financial structure and expected change in net worth.

A different method is used for the situation where the dairy farmer is already farming, and faces the need to improve productivity. Here, marginal analysis is used. This is done using partial budgeting: either, annual 'steady state' partial budgets to define expected extra return on extra capital invested as a 'first look', and partial discounted net cash flow budgets to define NPV at the required rate of return and the Internal Rate of Return. Such partial budgeting would provide an estimate of the extra return on extra capital invested in developing the existing operation, Farm A, into intensified Farm B or Farm C types of operation.

The results from the Ellinbank ABC Farmlet trials have been re-analysed below using the methods just described. An investment-planning horizon of 10 years, and four years of actual data, has been used in the analysis. As in the original analysis Farm A, B and C are first analysed as discrete investments, and not in the preferable way as development options of an existing Farm A. The approach of analysing the farmlets as 97ha dairy farms has been retained to test the conclusions drawn from the original analysis against conclusions which may emerge when the analysis is done in a different way. (However, using 97 ha operations as the setting for *each* of these businesses operating at vastly different levels of intensity may not be all that sensible in practice). The summaries of results are shown below.

The conclusion from the results is that of the three discrete types of farms, each involving different amounts of total capital invested, the one with the lowest capital investment Farm A has an expected annual nominal return on capital of around 9 per cent, while the more intensive operations, with considerably more capital invested, have expected nominal returns of 7 per cent per annum, over the planning period. The IRR can be interpreted as the maximum interest that could be paid if all the capital was borrowed. Ironically the lowest debt (cheaper capital) option Farm A has the highest expected IRR while the higher debt have more expensive capital options, Farms B and C, have the lower expected IRR. In terms of absolute profit, farms B and C generate much more profit than farm A (Figure 3). If a relatively low risk opportunity cost criteria of 8 per cent nominal after tax (5 per cent real) was applied, only Farm A earns more than the opportunity cost (Figure 2). A required annual real rate of return after tax of 5 per cent could be equal to 10 per cent per annum nominal returns before tax and some life style considerations, and could in many cases be regarded as being commensurate with reasonable returns from off-farm investments (as an example returns in the share market in the past have been around 10 - 15 per cent nominal per annum on average, albeit with wide dispersion around this average in any year).

In terms of financial feasibility, the cumulative net cash flows in Figure 4 indicate that after 10 years, Farm A is likely to have repaid all debt and accumulated an expected net cash surplus of nearly $600,000 (year 10 nominal dollars). Farm B is likely to be close to having fully repaid all debt, and Farm C has an expected cumulative net cash deficit of approximately -$500,000.

Figure 1. Comparing the nominal IRR of three different whole dairy farming systems (Farms A, B and C)

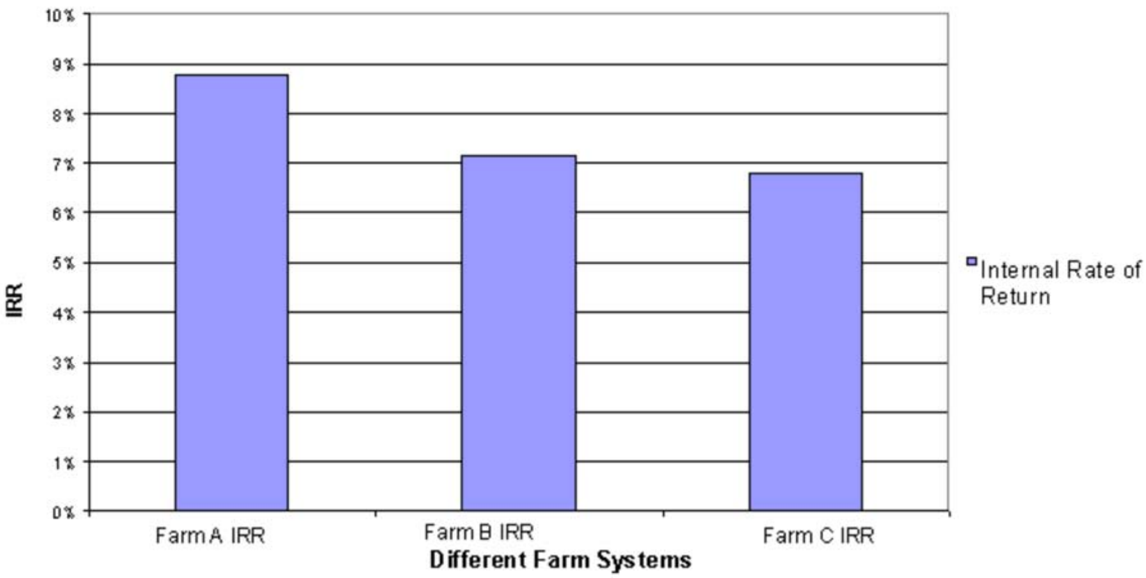


Figure 2 - The NPV of three different whole dairy farming systems

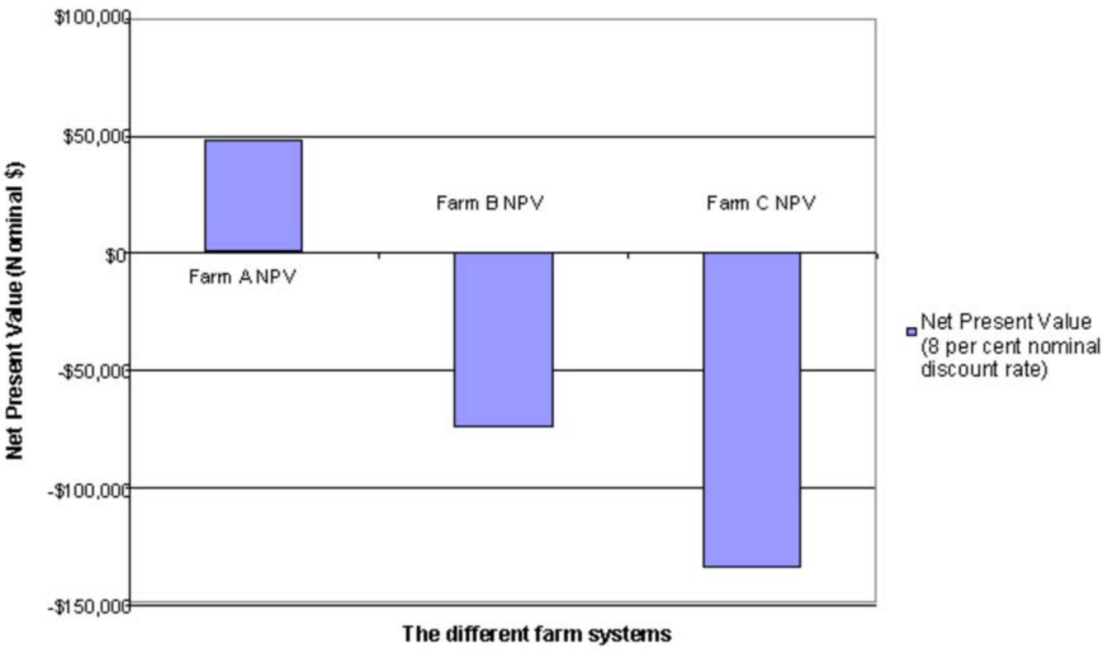


Figure 3 - Annual Nominal Net Cash Flows, comparing three whole dairy farming systems

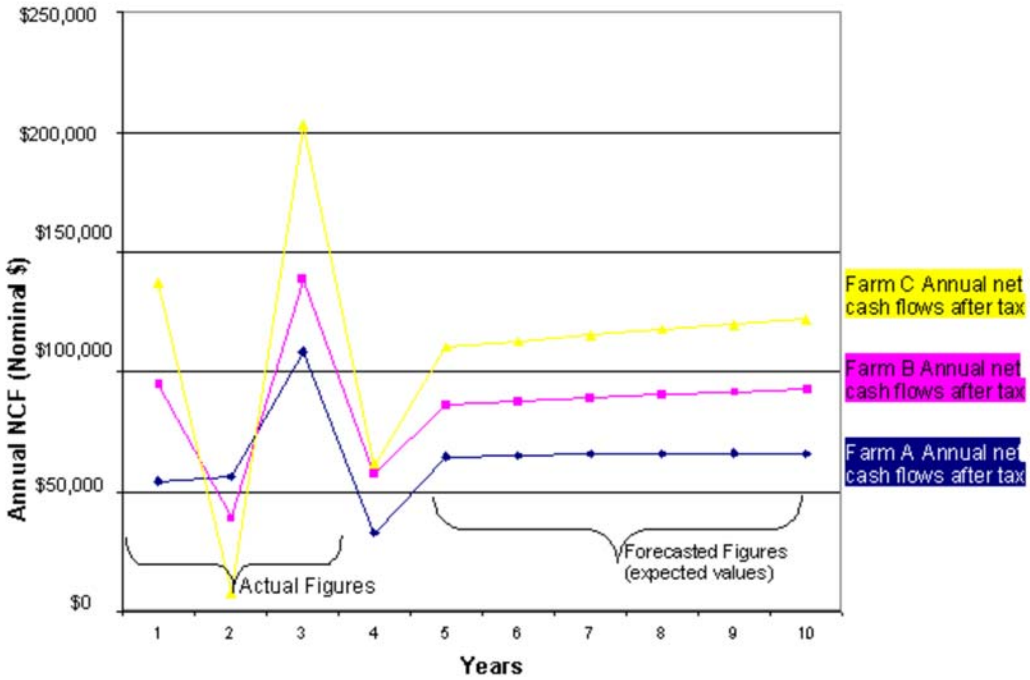
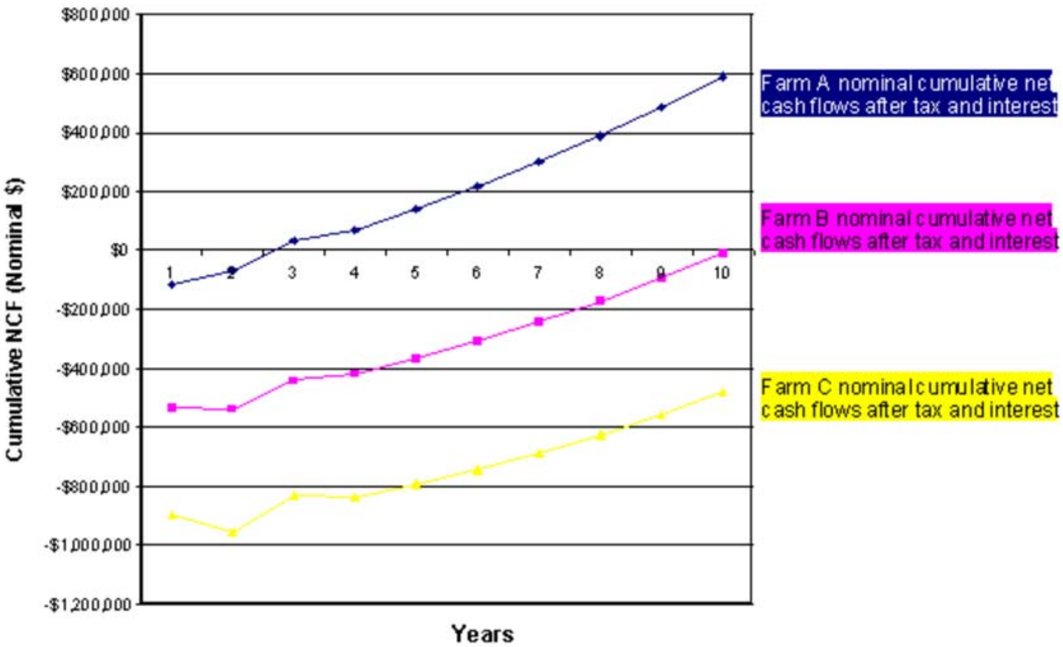


Figure 4. Cumulative NCF of the three farming systems



In terms of measures of annual debt servicing ability, expected annual net cash flows available to service debt for years 5 to 10, of each option, are shown in Figure 3. Farm A is likely to have around $70,000 net cash flow annually, Farm B is likely to have around $90,000 net cash flow annually, and Farm C is likely to have around $105,000 net cash flow annually, available to service debt. If a 15 year amortised loan (8% per cent per annum nominal interest) on initial debt was used, annual debt servicing requirements would be - Farm A $18,384, for Farm B $67,931, and for Farm C $111,522. This indicates that under these terms Farm C would not be likely to be a financially viable option. Figure 3 also shows the variability of the cash flows for each option. Looking specifically at years 1 to 4, where actual figures have been used, Farm B and C are more vulnerable than Farm A to changes in the cost of inputs, especially bought in feed as was the case of dry seasons and high grain prices in year three. These cases demonstrate the well-known phenomenon whereby intensification can increase both the mean and variance of net farm incomes.

Approaching the question for the case where a farm such as Farm A was already owned, and further investment was being contemplated to change from a Farm A to a Farm B or C type of operation, the expected extra annual real return on extra capital is around 1 per cent which is unlikely to be an attractive option compared with alternative investments on or off farm. This does not say that it is not sensible to invest to lift productivity on Farm A - it is just that it is more likely to make sense to do so in ways *that are different to either of the models of* *intensification represented by Farm B and Farm C*. An obvious example would be to intensify Farm A by investing to add 20-30 per cent land area, with maybe some low cost modification of the dairy and pasture improvement, enabling Farm A to carry and milk more cows and spread overheads over greater output.

Including value of land in estimating costs of producing pasture

Attempting to estimate the cost of pasture production has become a popular pastime in dairying circles in recent times; most commonly a result of non-economists trying to answer the question of grain versus pasture as sources of feed. In Table 2 is a summary of recent papers and key quotations which encapsulate the 'reasoning' of protagonists for trying to work out the 'cost' of pasture, and the ways they have tried to do so. From Table 2 it can be seen that the growing costs of pasture are all calculated in different ways, and that most authors whom try to work out the 'cost' of pasture include the cost of capital tied up in land, and, sometimes in plant and stock.

However, the attempts to measure the cost of producing pasture in a pasture based dairy investment is, in a farm management economics sense, non-sense. This is yet another case where the perspective is wrong and the wrong question is being asked. The points about perspective and the question being asked can be illustrated as in Figure 5.

Dairy farming involves using a mix of capital resources - land livestock and plant and machinery - these have associated fixed costs, to which variable costs are added over the production period, in order to produce output. The major intermediate output is grass that becomes a final output which is milk, which comprises mainly butterfat, protein and water. Profit is what is left over after the variable

costs and the fixed costs have been accounted for and is the return to all the resources that have not been 'rewarded' in the calculation. This is called operating profit, and when expressed as a percentage of the total capital invested in the activity is a measure of the economic efficiency of the use of that capital. If the question is 'which system of producing milk is likely to be more efficient out of a number of alternatives?' - the criterion is which system is most likely to have the highest return on total capital invested. To answer the question which farm system is likely to be most profitable or most efficient requires a whole-farm budget of expected operating profit and an estimate of expected return on total capital.

As a dairy farm is producing milk, not grass, it is net return (final product income minus variable and fixed costs) on all the capital invested in the system which is the relevant measure of performance. There are many ways to combine capital, with its associated overhead costs, plus pasture variable costs plus cow variable costs, to make milk and ultimately profit. *Estimates of the cost of production of an intermediate output of the business do not answer any relevant question*. Regardless, allocating all the opportunity costs of all the capital tied up in the business to the pasture harvested would not be sensible - some of the farm capital contributes to milk via pasture, but some capital contributes to related activities not directly to do with pasture.

If comparing two systems in terms of some measure of pasture costs, implicit is the assumption that the non-pasture capital component is the same for the two systems. Take for example, a comparison of a system that is relatively extensive with a system that is more intensive. Each will have different total capital invested, they have different amounts of capital associated with feed supply, different un-allocated variable costs such as fertiliser, different herd replacement system costs, different labour to capital mixes, and yet arbitrarily, all capital is allocated to pasture. Allocation of the cost of bits of capital to bits of a farm - called morselization of a farm - loses the essence of the whole of the business; the whole is greater than the sum of the arbitrarily carved up bits.

Table 2 Various papers about the cost of pasture in dairy farming

Author - Paper Title	**Quote**	**Method**
Sandles, 1997 'Where has all the money gone'	'With current management practices pasture is rarely our cheapest feed source' (p 13)	First an estimation of growing costs (including variable costs, labour, repairs and maintenance, depreciation and land value) This figure is then divided by the efficiency of harvest.
Dickens and Fitzgerald 1997 'The Economics of High Feed Inputs and Irrigation'	'Land on a dairy farm is there to grow grass, so cost of ownership of land and improvements directly related to growing pasture must be considered as a charge against the production of that feed'(p 35)	These authors estimated the growing cost of pasture and then charged annual net interest of 8 per cent on land value and improvements, then added repairs and maintenance to structure, to come up with an estimate of annual fixed costs of pasture growing.
Beca, 1997 'Maximising profitability on pasture based dairy farms'	'The full capital costs of land, buildings, stock and plant should be covered by pasture production alone, while these remain the accepted foundation capital costs of the business. As returns on this capital are the measures of profitability it underscores the importance of ensuring the total pasture production is maximised and at the highest percent possible is converted in milk production' (p 18)	In this paper the total capital employed is estimated and an interest charge is applied to this. Then the total energy supplied, and the total energy from pasture, with a certain percentage of imported feed, is estimated in terms of megajoules of metabolisable energy per hectare. From this information, the estimate of the capital cost of pasture harvested, is calculated with the kg DM per ha harvested. The variable costs are then added to this figure.

MacMillan 1997 'A personal SWOT analysis of the NZ dairy industry'	'.ignoring land costs in the feed production equation is not desirable for internal comparisons of the cost of production in New Zealand'. (p)	
Moran 1998 'The real cost of pasture.'	'.costing grazed pasture is always a controversial topic, partly because of the inconsistency of the various methods used. Grazed pasture can be cheap or expensive, depending on how it is costed.'(p 50)	The author divides pasture costs into three categories, variable costs, overhead costs and capital costs. Capital costs are defined as those associated with the land on which the pasture is grown.

Figure 5. Summary of the structure of a dairy farm

Including an opportunity interest charge on the capital tied up in the land and improvements, livestock, plant and equipment, is only relevant where the option being considered is to buy into dairy farming or where the options being considered includes selling the property and investing the total capital invested elsewhere. Otherwise, where the decision-maker already has invested in dairyfarming, return on marginal capital invested is the indicator of interest. If it is intended to continue with the capital invested in the current use (i.e. continue farming on the existing farm) and not to sell the farm and invest it elsewhere, then the capital invested in land and improvements is for the time being (the current planning horizon) sunk in that use. It has no relevance to the next decision, which is about how to increase returns from resources currently controlled by the operator plus new resources that may be brought under the operators' control. The approach then ought to be: 'if I have a farm and I invest extra capital into developing this property (or anything else for that matter), what is the expected return on the marginal capital from doing so?'

There is another major problem with attempting to estimate the cost of pasture. In economic analysis some costs are based on the value of an asset and the value of an asset reflects the expected future profitability from that asset. The peculiar nature of land as an input needs to considered. Land values are determined by profitability not land uses. If expected future profitability of an asset such as land is high, the value of that land is high, and so is the interest opportunity cost of that capital invested in that land. For example, an increase in the milk price may lead to an increase in profitability, which increases the value of the capital invested, which increases the opportunity interest cost of the capital. In turn, if the opportunity interest of capital is used in estimating pasture costs, this increases the cost of pasture estimated in this way. With this approach, this in turn reduces the apparent profitability of milk production until the earnings of capital in dairying equate to earnings of capital elsewhere in the economy. The more useful way to look at the question is simply 'What is the return on total capital in this dairy farming system and how does this compare with returns on total capital in alternative investments?'

There are further problems: average costs of an input or output cannot indicate what is the profitable amount of milk to aim to produce. There is no way of knowing from average cost if too little or too much output is being produced. Average cost of production estimates are usually backward looking, arbitrary, cannot handle joint products, and will vary greatly with technical efficiency. Costs attributable to other enterprises need to be separated, but this is necessarily arbitrary, and it is confounded by complementary and supplementary and competitive relationships between inputs. Seasonal fluctuations, random effects and productivity trends over time affect any estimated average costs of production.

Thus, the proper perspective to bring to bear on the question of the profitability and efficiency of dairy production systems based on pasture, is to look at the return on total capital from a system operating in a particular way, compared with what the return on total capital could be with that system operated in some other way. Or, the comparison could be what would be the return on total capital if that capital was invested in some other alternative use, with allowance for different riskiness of the various points of comparison. If different ways of running a particular system are to be compared, then whole farm and partial budgets are required: again the measuring stick is the expected extra return on any extra capital invested to change the system.

Comparative Benchmarking

Mastery of information is an essential part of farming successfully. The approach used in traditional farm management economics to questions of evaluating performance and identifying areas of productivity gains is to bring appropriate mixes of disciplinary knowledge about human, technical, economic, financial, risk, and institutional aspects of a particular farm business; and then to use this information to analyse the resources available, the potential and the constraints. Options for the farm business are budgeted out, including risk considerations, non-monetary aspects taken into account, and decisions are made and implemented, outcomes monitored, and plans adapted as reality diverges from the expected.

Benchmarking activities also generate information and if it is soundly based in theory and practice, such information may well have some value to someone. (Remembering of course that in competitive economic activities, the value of information can be in direct proportion to the number of people who have access to it). A commonly presented defence of benchmarking activities is that anything that gets farm business people focussing closely on the important aspects of their business is a good thing! That is, benchmarking may be an exercise in learning the fundamentals of farm management.

This may be true - though the best operators would already be on top of these useful ways of thinking about how their business works and is working. Generally though comparative analysis activities stop where the real decision making action gets started - that is, benchmarking activities beg the question ' So, now what do we do?'. And, this is where the traditional farm management budgets come in. Regardless, if it is at least the case that benchmarking activities are primarily about general farm management information and education, then it is imperative that the concepts and measures used are soundly based in farm management theory - simply on the grounds that if you are going to teach people something, it should be correct (ie. the best available knowledge at the time). But farm-benchmarking activities as presently, popularly and lucratively embraced are not always built on sound theoretical foundations.

Limitations of Benchmarking

In farming, how is the modern emphasis on 'Benchmarking' different from the old and well-discredited notion 'Comparative Analysis'? Not much, no matter how it is dressed up. Let us get it straight - there are some very useful financial ratios which, when used collectively and over time for an individual farm, can tell a lot about the performance of that business (see any financial management text). It is another story to argue that farmers can find out much about how to run their own farms by looking at the average of technical and financial measures of the performance of parts of other peoples farms. For information about a group of farms to be relevant for decisions of any one farm operation in the group requires at least that:

- all farms in the group are operating on a sufficiently similar production surface;
- the effects of nature are sufficiently similar on all farms within the group;
- owners/managers of all farms in the group have sufficiently similar abilities, objectives, stage of life and attitudes to risk; and managers of all farms have sufficiently similar time horizons.

Do these above points really comply with the reality of agricultural socio-economic systems? The benchmarking concept has more relevance the more homogenous and controlled is the production system, and the more the measure for comparison is a well defined element of the system - such as an activity which is part of a manufacturing process, where what was done yesterday will be precisely the same tomorrow. Farming is not much like this. Indeed, benchmarking may well be mainly about 'morselization' of a whole activity into component parts for comparative purposes - the contrast with whole farm analysis could not be greater.

The theoretical and practical case that technical efficiency measures of productivity are meaningless for management has been well made, definitively by Candler and Sargent in 1962, and then by Mauldon and Schapper in 1970 and 1971. Candler and Sargent's article 'Farm Standards and the Theory of Production Economics' demolished the idea of average technical ratios of parts of performance as being in any way a sensible basis for analysing management decisions, largely by demonstrating that two alternative technical efficiency measures, such as average production per animal, or average production per hectare, can lead to logically opposite conclusions. If you wish to maximise production per animal you would have less animals per hectare. If you wish to maximise production per hectare you would have more animals per hectare. Technical benchmark ratios are compounds of numerous factors, and either of these methods could be the most profitable, depending on economic considerations.

Farm businesses are usually characterised by average total costs (Fig 6) which initially decline as production increases and overheads are spread over more output. Average variable and total costs may then be relatively constant over a range of output, and can increase if inefficiencies arise from increasing size of operation. Marginal costs tend to increase as output increases, as diminishing returns to variable inputs sets in (as shown in Fig 6). Maximum profit in the short term is made at the production level where marginal costs of extra output is almost equal to price received per unit of output.

Figure 6. Short run average and marginal costs

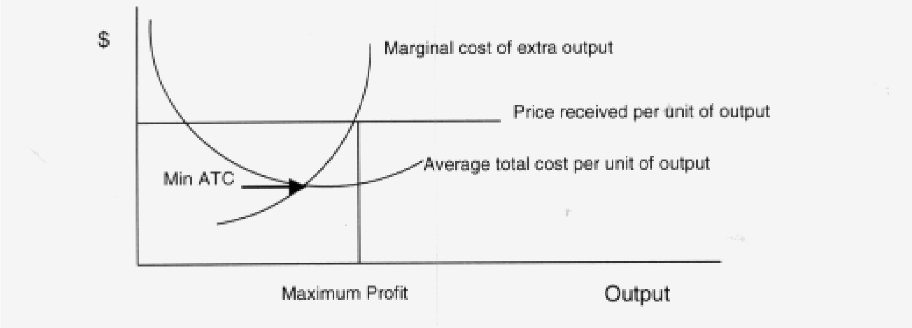


Figure 6. Short run average and marginal costs

A ratio sometimes used in evaluating the efficiency of milk production is the average return above average feed costs. Maximisation of this ratio suggests that the farmer should produce at the point where average feed costs per unit of milk output are minimised (assuming a constant marginal revenue). However, as shown in figure 6, minimising average costs (variable or total) is not the profit maximising point of production; producing more units of output up to the point where marginal revenue equals marginal costs can increase total profits. A related measure used commonly is average margin from pasture per megalitre of irrigation water. Maximising this ratio implies that the farmer should produce at the point where average water costs per unit of pasture are minimised. To follow this rule would be incorrect - again maximum profit is where marginal revenue from an input equals marginal cost.

A related technical ratio, which is currently popular, is irrigation water use efficiency - the ratio of average physical output of something to the amount of irrigation water supplied. This ratio, like all technical ratios tells nothing about economic efficiency - though the underlying notion that a high technical efficiency ratio is better than a low technical efficiency ratio, especially when irrigation water is coming under increasing scrutiny and is, at times, obviously scarce, seems sensible. Still, in these times of tradeable temporary and permanent water rights, any water use efficiency ratio which is found to exist on an irrigated farming operation where the operator is well informed about the options is, by definition, the economically efficient technical efficiency ratio for that farm operation. Otherwise the water would have been sold and used in another way.

Mauldon and Schapper further discredited comparative analysis by turning their attention to the question of whether comparing average gross margins of activities between different farm systems is of any use in management decision making. They argued that comparing historical gross margins is flawed because management is about the future, and comparing expected gross margins is flawed because gross margins include estimates of costs that are in turn a function of expected profitability, such as for livestock depreciation or appreciation where expected value of the livestock is estimated. These estimates are subjective and are unique to the estimator.

The notion of a leagues table of the top ten per cent of farmers indicating something useful is also dubious. As Candler and Sargent put it, the make-up of the top ten per cent of farm businesses in any time period is to a considerable extent an arbitrary measure because which farms are included in the top ten percent of farms depend among other things, on the criteria of success and the weighting used to aggregate the resources in the products. For example, of two farms with the same production possibilities, one may appear in the top ten percent simply because in this year the prices happen to suit the input and output combination chosen. That is, in any year, the top ten per cent may include farms operating on generally lower production possibilities frontiers than some of the farms in the bottom ninety per cent.

Also, implicit is the notion that farmers in the top percent in any year are using their resources very well, and farmers below that are using their resources less well - whereas in fact a farmer with excellent resources could be performing terribly but still be in the top ten percent as measured, and a farmer with terrible resources could be performing in an excellent way in the bottom ninety percent as recorded. The population of farmers at various positions on the league ladder will not be constant not only because of random effects but also by design. At different stages of their career different farmers do different things. Regardless of the above-mentioned points, as any farmer tells, what you plan to do and what happens are different things - the fact is that decisions are made now and the results which place your operation somewhere on the leagues table happen later, and as a result in part of things happening which were not included at all or not weighted in the decisions as they would have been with the benefit of hindsight.

To sum up, the main criticisms of the value of comparative analysis/benchmarking exercises, from the vast literature on the subject, include:

- each farm family is unique, as is their goals, resources, abilities, and attitudes to risk and so on.
- farm management is about the future not the past;
- farming is about changing to new production frontiers, and re-organising marginal resource use;
- no two farms are on the same production function;
- averages are artificial constructs;
- averages do not enable optimising decisions;
- aggregation of inputs and outputs is fraught with problems of measurement;
- changes in valuation of livestock changes rankings of livestock activity gross margin;
- if differences in activity gross margins are small, error in the estimates will mean no sensible conclusions are possible;
- labour is often used because it is free;
- technological change over time moves operations to new cost levels;
- some farms are growing, some are static, and the average is an average of these - individual trends are more useful;
- average cost is a year round average but seasonal variations and price variations occur;
- comparative analysis may suggest a weakness but does not determine the cause of the weakness;
- benchmarks should be ones that you can control, and be related to profit;
- diminishing returns and complementarities are important;
- benchmarks imply a cause and effect which may or may not be true, and which cannot be ascertained without case studies;
- differences in residual income measures are due to both random and management effects, and the potential contributor of either of these effects to the eventual outcome in any year can be huge - especially in an agriculture as variable and risky as agriculture in Australia;
- ratio comparisons resulting in significant deviations 'from the norm' reflect only symptoms of a problem. Further analysis of the financial information and investigation into the operation of the business as required to isolate the causes of a problem;
- only when a comprehensive group of financial ratios is used can reasonable judgements be made; and
- the timing of the data used to form ratios is critical, as also is any inflation effects on values.

Of the many possible criticisms of benchmarking as the concept and practice as applied in Australian agriculture, perhaps the most telling is that benchmarking cannot be used to evaluate applications of new agricultural technology - when successful adoption of new technology is the key to farm profitability over time.

Benefits of Benchmarking

The alternative view, and a view supported by those controlling large agricultural research budgets in Australia, is that farm benchmarking has a valuable role to play in improving the productivity of farming. One benefit of benchmarking activities claimed by some practitioners is that it results in the establishment of another data base about aspects of modern farming life in Australia which supplements other official data sources, and which has uses in aggregate level industry analyses and policy investigators.

Defenders of comparative analysis, such as Blagburn (1962) who pioneered the use of farm standards in the UK, argued that despite its weaknesses, the role of farm standards (benchmarks) is to identify weaknesses, not set targets. It is intended to be a diagnostic tool. The argument goes that the farmer whose crop yield is low (compared to something presumably optimal) is more likely to try to improve his/her farming if he/she knows it is low, than if he/she does not know this (Blagburn 1962). This is not profound. In more recent times in a paper entitled 'The Generation and Use of Standard Data for Farm Management Advice' Errington (1989) noted that effective management is concerned with taking and implementing good decisions in the light of the information available at the time, and standard farm data is one of these sources of information. It is often argued that the most important function of comparative analysis is simply to encourage the farmer/manager to look critically at their cost structures. Errington repeats Blagburn's point that the technique is merely a diagnostic tool and is not a planning tool.

Undoubtedly, as in most things, there is a grain of truth in the concept of 'compare and contrast' to learn something about something. There may be some insights from looking closely at why something is different on someone else's farm to your own (ie. walking the neighbours paddocks as well as your own), and relating that back to the differences in resources, in family labour, in family skills, in interests, in stage of life, in access to capital, in gearing, in attitude to risk, in management skills in a technical and financial sense and so on, once the detail of each system is well defined. There is a sense in that this is what farm consultants with a group of clients are doing all the time - however, there is a marked difference between what consultants are doing with their clients and the rampant empiricism of the current popular benchmarking activities.

Measures for assessing farm businesses

To the extent that there is some general 'educational' value of the widespread, and growing, group benchmarking activities, then the minimum requirement is that the measures used should be theoretically sound and consistent. So, what are useful indicators of the state of health of a farm business? Any survey of the farm management literature of the US, UK and Australia (and business management literature in general) will find support for the following being useful indicators for the health of a farm business (See appendix 1). Firstly, measures of profit and economic efficiency, which means in essence trends in actual operating profit and return on total capital and expected operating profit and return on total capital. Second, indicators of liquidity and debt servicing ability (coverage) are critically important. Essentially this means measures of actual and expected net cash flow after consumption and tax and allowance for capital replacement, and maybe new investment out of cash flow, and before interest and principal, then, actual/expected net cash flow after interest and principal.

Related to both the profit and cash indicators are important measures concerning structure of the balance sheet at start and end of planning period, net worth, gearing ratio, equity percent, and the current medium and fixed term nature of debts and assets and changes in these measures over time. When it comes to assessing, and tackling, the health of a business, these above-mentioned profit, cash and balance sheet benchmarks for the near past and near future (planning period) of an individual business are by far the most useful indicators of business health. While financial ratios on their own are meaningless, it is important not to confuse criticisms of use of financial performance ratios in the context of their limitations when used in comparative analysis, with the useful role of financial performance ratios in analysing the trends in performance of a particular business over time. As Mauldon succinctly put it, 'you can only compare yourself with yourself'.

The DRDC conducted a Farm Benchmarking Development Project in order to get some consistency of approach and definitions in the dairy industry, and to show how some of the above-mentioned indicators can be used in benchmarking (Teese 1997). The agreed terms and definitions are shown in Appendix 2. Even though the emphasis on benchmarking remains of dubious merit, the emphases, terms and definitions are sound, as the measures are at least consistent with farm management economic theory. The distinction between profit and cash is clearly made, and measures emphasising profitability, economic efficiency and financial viability make up the key performance indicators.

Furthermore, as an aid to benchmarking activities, the Livestock Improvement Corporation of New Zealand created a new measure called Economic Farm Surplus (EFS) **1** . This is said to be a measure of farm financial performance. Economic Farm Surplus is described variously as 'measuring farm cash profit' (Dairy Exporter, April 1998, p14) and as 'a simple measure of farm profit' (Livestock Improvement Advisory Bulletin 1997, p1). Economic Farm Surplus is defined as follows:

Cash Income (Milk + Stock)

- Farm Working Expenses

- Depreciation

- Runoff Adjustment (If runoff is owned and not leased)

+/- Stock Adjustment (For changes in opening and closing stock numbers)

- Labour Adjustment (Managers Wage, additional unpaid staff)

= EFS

Economic Farm Surplus has been developed to facilitate comparisons of financial performance between dairy farms. To this end, some standardised adjustments are made to the usual financial accounts prepared for dairy farming businesses. (The detail of these adjustments is shown in Appendix 2). The intent of EFS appears to be to define some notion of surplus from the resources used; however, a mix of annual cash and non-cash and capital investment items are involved, and the resulting measure measures neither true net cash flow nor true profit. Following criticisms that EFS did not allow measurement of return on capital (MacMillan 1997, Clarke and Shadbolt 1998) a second stage of the Livestock Improvement Corporation's EFS program, covering rate of return on capital, is being developed. Clarke and Shadbolt (1998) criticise the EFS because they say it emphasises minimising operating costs more than profitability and financial viability; and fails to account for changes in stocks of supplements; it can include 'one off' capital expenditures; it values unpaid labour; and it does not sufficiently emphasise return on capital, gearing and debt servicing ability, and growth. These researchers concluded EFS is not a measure of overall business management excellence.

Finally, in the 1950's Keith Campbell wrote scathingly about agricultural scientists going around bothering farmers to 'get the facts' about 'what is' and then Archimedes-like running through the streets shouting Eureka, but having no theoretical principles on which to make sense of the empirical information collected or to say anything sensible about what ought to be done. It is disturbing to realise we have not only not made any headway in this area in all the years gone by but since then, seem to have gone backwards rapidly with massive resources wasted and better opportunities foregone because of the benchmarking emphasis in agricultural research and extension.

Sense in Dairy Farm Management Economic Analysis

Managing a farm business is a continual process of planning to do something and then changing intentions as time passes and new circumstances, different to those which were previously anticipated, dictate that different actions be taken. Managing a farm businesses is about manipulating resources in situations where much is unknown, to try to achieve aims and establish situations in a future which is unknowable. It is about deciding how the resources under management's control are best used to achieve objectives sometime in the future, when the only certainty is that 'the future will be a different world, they will do things differently there!'

Good decisions can be made with the aid of a few simple budgets which are built on sound technology and good guesses about the financial and economic factors which will be relevant to the industry and the business in the future planning period in question. Ultimately the management task boils down to making good judgements about how actions taken now in the business will turn out. *The key to making good decisions about how the farm business might operate is to have sound and thorough knowledge about how the business currently works*. The decision-maker needs to have in his or her head a detailed picture, accompanied by sensible numbers, about how all the bits and pieces of the business all fit together. Managing a risky business is very much about gathering relevant information, weighing it judiciously and acting accordingly. Some key bits of information about what has happened in an individual business is useful in forming judgements about what might happen, but the past is only of limited relevance to the future. Probabilistic ways of thinking are fundamental to farm management decision analysis, but usually there is not enough information to make full use of the potential power of probability theory in practical decision analysis.

Budgets are no more reliable than the data and judgements that go into them. Often much of the data used may be very uncertain. Sensitivity testing and breakeven budgeting do not solve the problem of uncertain data. But they do tell the farmer what might be the outcome if and when prices, costs or rates of performance vary from the 'most likely' levels. It is useful to explore 'sketches' of possible outcomes, saying in effect, if you do 'this', and 'this' happens, then the ultimate outcome(s) will be like 'this'. The decision-maker weighs up all the information in the light of many considerations and feelings, some of which are 'up-front', others are intrinsic. Scenarios and breakeven budgets are very valuable techniques to provide information in this decision process. The scenario approach involves first, constructing a budget including the key elements of the decision and then checking out a small number of the infinite, possible number of future events and outcomes. In any outcome there are only a small number of significant determinants. In any budget of possible outcomes, 2-3 variables will have the major impact on the expected result.

Most useful is the notion of breakeven levels of key parameters, ie. the level of a key parameter(s), which needs to prevail for the decision-maker to be as well off after the change under investigation as before the change. Breakeven numbers give decision-makers something 'concrete' to focus on - the chances of exceeding the breakeven level is then assessable. This is a particularly useful approach when, as is often the case, there is not a lot of information about the likelihood and level of performance of a key parameter involved in a change.

Fundamental to good farm management analysis and decision making is identifying correctly the real nature of the problem, bringing to bear on this the technical, human, economic and financial conceptual and analytical skills. The greatest difficulty with farm management analysis and decision making arises from the nature of the information that has to be used. Most of the information needed and used cannot be known with certainty. The vital information is about production responses to inputs and future events to do with seasons and markets. The numbers, which have to be used, are matters of judgement about the key aspects of farm activities and about the whole farm business.

Managing a grazing farm business involves daily manipulating the farm resources of land, capital, feed, animals and labour with the objective and hope that sometime in the future, the outcomes of the decisions and actions which have been taken will show more gain than cost.

Economic analysis does not have to be complicated; merely, the technical foundations of the analysis has to be sensible and the logic sound. The logic is: 'what is the situation', 'what is likely to be the new situation if I do this , or that, or nothing different at all' and 'am I likely to be sufficiently better off, all things considered, for it to be worthwhile doing this instead of doing that or doing nothing different at all'

Most significant decisions can be judged on the basis of a few simple sums in which the measurable bits of the situation are counted, with the results then tempered by consideration of the unmeasurable aspects of the case in hand. There are always some aspects of decisions, which are not measurable because response functions of particular circumstances are not known, and because the future is unknowable, and because, despite what is often implied by economists, a price cannot be put on everything. No amount of analysis can make the unknowable future knowable. However, it is sensible to think about the range of possible outcomes of doing some particular things in the unknowable future, and to think about how likely these outcomes may be. When it is not known what will happen, it is useful to think about what would need to happen for the action in question to turn out to be a good investment, and to think about how likely it is that the required levels of important parameters in the decision will actually happen. This approach is called the breakeven method, and it is useful when a situation being analysed has some key unknowns.

It is more profitable to punt in a reasoned, rational way in business decision-making than punting randomly. Good decision analysis boils down to well-informed, well-weighted consideration of all aspects of a situation: technical, human, economic, financial, risk, institutional. Elaborate analysis of some of these aspects of a situation can be extremely useful, but are not sufficiently useful to overcome or neglect other aspects of the situation, such as economic and risk aspects. If the future is unknowable and uncertain, does this matter? Well, it can; it often does. It is better to apply good rather than bad thinking to any problem. It is probably true too that doing analyses wrongly can be just as misleading as neglecting the analysis altogether.

Too often economic analyses of agricultural choices can be found in which fundamental principles of economic logic are violated; unfortunately, good agricultural scientists too often perpetrate bad economics, bringing high levels of rigour to their own field and accepting or perpetrating any old nonsense outside of their field. Why do economists get so agitated with non-economists efforts at economic analysis? A large part of the answer is that it is not hard to get the economics right and it is frustrating to see agricultural scientists get the economics wrong when the evidence from history is that the disciplinary rigour of scientific training makes an excellent foundation for applying economic principles and logic. So often, elementary errors are made and /or, even worse, scientists sometimes make up their own economics whilst blithely ignoring a couple of hundred years of profound intellectual effort which has gone into working out economics as a theoretical and applied discipline. The plaintive plea from the scientist when told that their pet idea is economic nonsense "Isn't there some other sort of economics you could do which would make the idea sensible?' does not cut much ice either.

Economists are accused of assuming away too much of reality (and it is not hard to find economists for whom reality is a special case!) but the irony of ironies is that it is the non-economist, the analysts who see just their part of the problem, or who regard virtually everything as being important *except* economic aspects of a situation, who are making the biggest assumptions, who are assuming away a significant part of the world. Good economists look at the whole of the problem, starting with the people and the technology, and get the economics, finance, risk and institutional bits right too. The decision analysis rule remains - measure what you can and think hard about what you cannot measure.

The main point to be made is that useful approaches to solving problems bring the appropriate balance of disciplinary knowledge to the question at hand and in agriculture. Even though, often, most of the story is of a technical and human nature, there is nearly always economic, financial and risk dimensions to a situation and these have to be considered in a logical serious way. Dimension can be at the level of the individual business environment and individual behaviour, or aggregate business environment and behaviour. Another way of seeing the meaning of appropriate dimension is the boundaries defining the focus of attention - the circles the 'systems' devotees draw around distinguishable aspects of a situation. Good farm management consultants and economists have always had to draw the boundaries of their focus around the whole farm and deal seriously with all the human, technical, economic, financial, risk and institutional dimensions of the questions they analyse. This whole business approach comes naturally when you start by walking the paddocks with the farm family.

What common mistakes do agricultural scientists and technologists make in problem analysis and problem solving? Mostly, the mistakes are elementary. For example (accountants too make many of these errors):

- Failing to get the perspective right; that is, the with/without, before/after comparisons;
- Failing to consider all the important connections within the system in question at any point in time, and the related changes that result from a change in how a business operated. Often this stems from using single year activity analysis (gross margins budgets) instead of whole farm budgets, partial budgets and budgets over time. ie. where you are hoping to get to, and how. The main thing economic thinking reveals is that nothing is quite what it seems because of the dynamics of the real world.
- Succumbing to the tendency to find 'the' problem where you look (in the field you know best) as against looking everywhere widely to find the real problem.
- Confusing real and nominal terms (dollars and interest rates) into meaningless hybrids.
- Using change in yield as a proxy for change in profit.
- Using crude measures like gross margins or DSE's for anything.
- Uses averages of anything at all (it rarely happens).
- Failing to appreciate the difference between economic and financial analysis - often a hybrid analysis results which pulls off the unique double of getting both the economic and financial aspects of the situation wrong. (Economics tells you if it is worth doing, finance tells you how much cash is involved, and when). Both aspects are important.
- Overlooking or under-rating risk
- Violating the rules of investment analysis by not accounting adequately for the possible effects of time on the value of money - as it is, few people understand what is going on with discounted cash flow methods, let alone the implications of the implicit assumptions being made with the method.

- Failing to take account of the taxation aspects of a decision - there is always a tax angle.
- Treating the past as a predictor of the future - the future is a different world, they will always do things differently there.
- Failing to identify separately the 2 - 3 key factors, which determine outcomes in any situation, and instead treating everything, the big and the little, as being equally important. Often the outcomes of analyses hinge critically on one or two critical assumptions - the sensitivity of outcomes to changes in this key variable needs to be examined closely.
- Looking at too few, or too many, scenarios. There are always only a couple which count.
- Insufficiently recognising the extent to which the results of analyses derive from one or two key assumptions made about key numbers - the result is only as valid as the least valid important, number in the analysis.

Finally

It is as easy to get it right as wrong - so more sense and less nonsense is the call.

References

Anon (1998), 'Second stage on way', New Zealand Dairy Exporter, 73(10), 14.

Anon (1997), 'Economic Farm Surplus', Livestock Improvement Advisory Bulletin

Anon (1996), 'Benchmarking: lifting profitability beyond the average', Research Note 40 Dairy Research and Development Corporation.

Beca, D. (1997), 'Maximising Profitability on Pasture Based Dairy Farms', Large Herds Australia Conference Proceedings, 13-21

Blagburn, C.H. (1962), 'Farm Standards and the Theory of Production: A Rejoinder', Journal of Agricultural Economics, 15(2), 291-295.

Boehlje, M. (1992), 'Evaluating Farm Financial Performance', Journal of the American Society of Farm Management and Rural Appraisers, 109-115.

Candler, W. and Sargent, D. (1962), 'Farm Standards and the Theory of Production', Journal of Agricultural Economics, 15(2), 282-290.

Clarke, B. and Shadbolt, N. (1998), 'Evaluating the profitability of your dairy farm: is EFS everything?' Massey University No. 4 Dairy Farm Field Workshop February 1998

Dickens, A. and Fitzgerald, B. (1997), 'The Economics of High Feed Inputs and Irrigation', Large Herds Australia Conference Proceedings, 22-36.

Errington, A. (1989), 'The generation and use of standard data for farm management advice', Farm Management, 7(1), 17-25.

MacMillan, J. (1997), 'A SWOT analysis of the New Zealand Dairy Industry' Report.

Mauldon, R. and Schapper, H. (1970), 'Random Numbers for Farmers', The Journal of the Australian Institute of Agricultural Science, 36(4), 279-284

Mauldon, R. and Schapper, H. (1971), 'The Sensitivity of Interfarm Comparisons to Inaccuracies of Measurement and Valuation', Review of Marketing and Agricultural Economics, 39(2), 107-118.

Moran, J. (1998a), 'The real cost of pasture', The Australian Dairyfarmer, 13(5), 50-54.

Moran, J. (1998b), 'How much do pastures really cost?', The Australian Dairyfarmer, 13(6), 32-34.

Mulvany, J. (1997), 'ABC Whole Farms Economic Analysis', On Farm Consulting Pty Ltd

Passioura, J (1973), 'Sense and Nonsense in Crop Simulation', The Journal of the Australian Institute of Agricultural Science, 39(3), 181-183.

Sandles, L. (1997), ' Where has all the money gone?', Dairy Journal, 12-13.

Appendix 1: Useful indicators for assessing the health of the farm business

In the United States of America the question of assessing the performance of farm business in a consistent manner was dealt with by the establishment of a Farm Financial Standards Task Force to develop commonly accepted definitions and ways of measuring farm performance (Barnard 1991, Boehlje 1992). The measures this committee proposed, focused on, profitability, solvency, efficiency and repayment capacity, and used profit and loss, cash flow statements and balance sheets as sources of the information required.

A refinement of this approach, suggested by Boehlje, is to add indicators to do with reinvestment rate and cost containment and cost control. The MIMD (Maximum Information from Minium Documents) evaluation system was developed. The key financial measures from the MIMD system are shown in Table A1. Boehlje also cites the duPont Analysis System (Figure A1). The rationale for this approach is that return on total assets and return on equity are the critical indicators of performance, and these returns are determined by operating profit, capital turnover and gearing.

A simple form of analysing the health of a farm business, and one that is totally consistent with these above-mentioned methods is:

A: Balance Sheet at the Start

B: Profit and Loss

- Farm Gross Income
- Minus Variable Costs
- Equals Farm Gross Margin
- Minus Overhead Costs (including operators allowance)
- Equals Operating Profit (or EBIT)
- Minus Interest Paid
- Equals Net Farm Income
- Minus Income Tax
- Minus Consumption above operators allowance (or plus any operators
- allowance not consumed)
- Equals Change in Equity

C: Annual Net Cash Flow

- Annual Cash in Farm Operations
- Minus Cash Variable Costs
- Cash Overheads
- Consumption Requirements
- Tax Cash Provision
- Cash Allowance for Capital Replacement and Investment out of annual cash flow Equals Net Cash Flow before debt servicing

Table A1 - Key Financial Performance Measures from the MIMD system

Measure	**Calculation**	**Interpretation**
Total Assets	The value of total financial and capital resources owned by the business as reflected on the year-end balance sheet.	The size of the business in terms of overall plant capacity.
Total Liabilities	The value of total debt obligations at year-end as reflected in the balance sheet.	The financial claims of lenders on the assets of the business.
Owner's Equity	The value of the owner's financial claims on total assets as reflected on year-end balance sheet.	The owner's financial stake in the business - his or her financial commitment.
Debt to Asset Ratio	Calculated as total liabilities divided by total assets.	The basic leverage in the business, ie. what proportion of total farm assets is owed to creditors.
Gross Revenues	The total value of products produced by the business on an accrual basis from the income statement.	The gross income available annually to cover expenses, debt servicing, living, expansion etc.
Total Expenses	The total of fixed and variable expenses incurred during the year as measured by the income statement.	The total costs incurred in producing the revenue this year.
Net Income	The income available on an accrual basis after fixed and variable expenses have been deducted.	The basic measure of the profitability of the farm operation.
Return on Assets	Calculated as net income plus interest expense divided by total assets.	An index measurement of profitability that indicates the profitability per dollar of assets, thus allowing comparisons over different size farms and different types of businesses/investments.
Current Ratio	Calculated as current assets divided by current liabilities.	A basic indicator of short term debt servicing and/or cash flow capacity; indicates the extent to which current assets when liquidated will cover current liabilities.

Debt to Income Ratio	Calculated as the ratio of term debt to net income.	Measures the longer-term relationship between income and debt and combined with information on debt maturity, indicates the ability of the firm to service debt from earnings over the long pull.
Reinvestment Rate	Calculated as earned equity or net worth change (assuming a cost basis on assets) divided by net income.	Measures savings behaviour ie the ability to save and reinvest part of what you make.
Asset Turnover Ratio	Calculated as gross revenues divided by total assets.	Reflects the overall efficiency in the use of assets to generate revenues, indicates the volume of business generated by the asset base (ie the flow of revenue through the asset pipeline).
Revenue Per Employee	Calculated as gross revenue divided by the person years of labour used in the farming operation.	The fundamental measure of labour efficiency; reflects how productive labour is and whether or not it is fully employed.
Operating Profit Margin	Calculated as net income plus interest expense divided by gross revenues.	Indicates operating margins and reflects the ability to increase revenues and control costs in such a fashion as to generate a profit.
Fixed Cost Percentage	Calculated as the sum of depreciation, interest, taxes and insurance divided by total expenses.	Indicates the proportion of total costs that are fixed or uncontrollable in the short run; many farm businesses encounter financial difficulty because of high fixed costs - this problem can be resolved only by selling fixed assets to generate more revenues.

(Cited in Boehlje, 1992)

Figure A1. Basic concept underlying the duPont system can be summarised mathematically

$$\underbrace{\frac{\text{Net Income} + \text{Interest Expense}}{\text{Gross Revenue}}}_{\text{[Operating Profit Margin]}} \times \underbrace{\frac{\text{Gross Revenue}}{\text{Total Assets}}}_{\text{[Turnover Ratios]}} = \underbrace{\frac{\text{Net Income} + \text{Interest Expense}}{\text{Total Assets}}}_{\text{[Return on Assets]}}$$

$$\Big(\underbrace{\frac{\text{Net Income} + \text{Interest Expense}}{\text{Total Assets}}}_{\text{[Return on Assets]}} - \underbrace{\frac{\text{Interest}}{\text{Total Assets}}}_{\text{[Interest Costs Adjustment]}}\Big) \times \underbrace{\frac{\text{Total Assets}}{\text{Equity}}}_{\text{[Financial Structure]}} = \underbrace{\frac{\text{Net Income}}{\text{Equity}}}_{\text{[Return on Equity]}}$$

(Cited in Boehlje, 1992)

Appendix 2: Economic Farm Surplus

ECONOMIC FARM SURPLUS: Economic farm surplus (EFS) is a simple measure of farm profit.

- **Cash Income** (Milk + Stock)
- - **Farm Working Expenses**
- - **Depreciation**
- - **Runoff Adjustment** (If runoff is owned and not leased)
- +/- **Stock Adjustment** (For changes in opening and closing stock numbers)
- - **Labour Adjustment** (Managers Wage, additional unpaid staff)
- = **EFS**

50% Sharemilkers - 50% Sharemilkers - use your own set of accounts to calculate EFS. This can be compared with other 50% sharemilkers, but not farm owners.

Variable Order Sharemilkers Variable Order Sharemilkers - Combine the accounts of the farm owner and the sharemilker to calculate EFS. This can be compared with other owner-operator farms.

CALCULATING EFS

Fill in income and expenses in the table on the back page of this FarmFact, using information which is in your financial accounts.

Net Stock Income (Stock Sales - Purchases)

If you have purchased milking cows during the season.

Exclude the cost of these cows when calculating Net Stock Income.

Also exclude these cows from a stock adjustment. If stock purchase is early in the season add them to the opening stock numbers, and stock purchases made late in the season should be removed from the closing stock numbers. This will ensure no stock adjustment is performed on these animals.

Off Farm Income

We are interested in profit from your dairy farm. Income which is not from your farm should not be considered in EFS. EFS does not include income from dividends/shares/interest, house rent. Income from rebates should be removed from the expense which it was related to, ie. For a fertiliser rebate remove this income from the fertiliser expense. Include income from supplements sold.

Expenses

Expenditure should be included in EFS as it appears in your financial accounts. Do not adjust for capital expenditure on fertiliser, repairs and maintenance or regrassing, this allows the argument, what is maintenance requirements and expenditure?

Standing Charges

Standing Charges includes rates, farm insurance, ACC and rentals.

Lease of milking land - The cost of leased milking land is not included. However, include the leased area in the total farm hectares.

Lease of milking cows - The cost of leased milking cows is not included. However, include the leased cows in the total cow numbers.

Interest - Don't include the cost of interest, which is usually included in standing charges. When comparing EFS between farms, we don't want debt to be the factor which is the major influence on EFS.

Depreciation

Include depreciation related to the farming system (plant, machinery and vehicles) not additional farm cottages or private vehicles. Do not include loss on sale of assets or depreciation recovered.

Estimate any adjustments using the tables below. Add them in to the bottom of the EFS table.

It is important that the basic financial information from your accounts is adjusted when calculating EFS, so all farming systems can be compared on an equal footing. The following are the adjustments used, and a brief explanation. Talk to your Consulting Officer or FarmWise Consultant if you have any queries.

Change In Stock Numbers *(also refer to Note on Net Stock Income*)

If stock numbers change between the start of one season, and the start of the next, this will affect stock income for the year.

If **stock numbers go up** then less stock will have been sold than usual. Stock income will be lower than usual, and we **adjust EFS up**.

If **stock numbers go down** income will be higher than usual, and we **adjust EFS down**.

Calculate the stock adjustment for your farm using the following table. The stock numbers you need can be found in the stock reconciliation section of your accounts.

	Opening No's (A)	**Closing No's (B)**	**Difference (B-A)**	**Value (1997/98)**	**Adjustment (Diff. x Value)**
R 1yr				$250	
R 2yr				$500	
Cows				$325	

R1yr and R2yr heifers - herd scheme values (based on market value) are used. Cows - ½ the herd scheme value is used, because most retained cows would have otherwise been sold as budget cows or culls at a lower than average market price.	**$**

Runoffs

If you **lease** a runoff, no adjustment is needed - costs appear in your accounts already.

People with runoff land have increased feed available to use for milk production. Those who **own** runoffs have operating expenses of the runoff included in their accounts, but have no expenses related to the capital value of the land.

Local Consulting Officers and FarmWise Consultants estimate runoff adjustment values for their regions, which are based on lease prices or 5% of the market value of the different classes of runoff land in the region. If you **own** a runoff, we **adjust the EFS down** for the value of that land to you.

Land Quality	**Area**	**Value**	**Adjustment**
Good (flat, fertile)	Ha	$	
Average	Ha	$	
Poor (steep, infertile)	Ha	$	
			$

Labour Adjustment

All unpaid labour is valued when calculating the EFS.

Some farms are managed by people who receive no direct payment for their work. Other farms employ a manager and/or staff to run the farm, whose wages do appear in the financial accounts. This can result in a significant difference in expense for otherwise very similar farms.

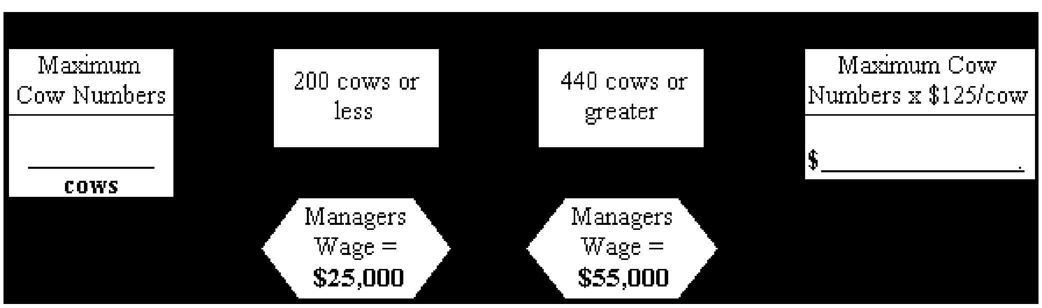
Wage for Management (a)	**+ Value of Unpaid labour (b)**	**= Labour Adjustment**
$	**$**	**= $**

Wage for Management

If the principal farm manager is employed, then the wage cost of the manager will already be in the accounts. **No wage for management is needed.**

If the farm manager is also the farm owner or 50:50 sharemilker, we need to include a wage for management in the EFS, to value the labour of that person.

Wages for management are $125/cow per maximum cow milked. There is a minimum wage of $25,000 and a maximum wage of $55,000, which corresponds to the marketplace.



Value of Unpaid Labour

Additional unpaid labour is valued by assuming that an average staff member works 2400 hours per year. **Estimate hours worked by unpaid staff members and calculate as a percentage of a full time labour unit .**

Calculate the EFS, and divide this by the hectares you milk on to work out EFS/ha. Calculate the EFS, and divide this by the hectares you milk on to work out EFS/ha. Milking area includes paddocks used for milking, and races, hedges, fences, farm buildings and houses which are in that area**..**

EFS CALCULATOR

GST Exclusive

Name		**Effective Milking Area**	Ha
		Runoff Area	Ha
Season			
Production	kg MS	**Maximum Cows Milked** Cows + Heifers	Cows

	$ TOTAL	**$/HA**
		(effective)
INCOME		
Milksolids		
Net Stock Income *		
Other Dairy Farm Income*		
TOTAL INCOME **(A)**	**$**	
EXPENSES		
Wages		
Animal Health		
Breeding/Herd Testing		
Shed Expenses		
Electricity		
Freight		
Pasture/Feed		
Fertiliser (incl N) *		
Weed & Pest		
Repairs & Maintenance *		
Vehicles		
Administration		
Standing Charges *		
Other		
TOTAL EXPENSES **(B)**	**$**	
CASH SURPLUS (A-B)	**$**	
ADJUSTMENTS **(see front page)**		
- Depreciation		

+/- Change in stock numbers		
- Runoff Adjustment		
- Labour Adjustment		
TOTAL ADJUSTMENTS **(C)**	**$**	
ECONOMIC FARM SURPLUS **(A-B+C)**	**$**	**$ /ha**

Footnotes

1 - Because the authors of this paper found it not straightforward to divine just what Economic Farm Surplus measured and meant and it seemed to vary a fair bit we have included the word on it from the Livestock Improvement Corporation in New Zealand - see Appendix 4

Date Created: 04 June 2005
Last Modified: (none)
Authorised By: Assoc. Prof. Bill Malcolm, Agriculture and Food Systems
Maintainer: Nanette Esparon, Agriculture and Food Systems
Email: webmaster@landfood.unimelb.edu.au