Marginal economics – are you making money from milk, or milk from money?

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Key messages

- Profitability from increasing milksolids (MS) production is determined by the cost of the additional MS (i.e., the marginal MS) and **NOT** the average cost of all MS produced;
- Profit/ha is maximised when the marginal cost of additional MS = the MS price;
- To be profitable, supplements cannot replace pasture: they must be used when there is a genuine feed deficit;
- The NARF results indicate that:
    - high MS responses to supplementary feeds can be achieved when there are strict decision rules that ensure high pasture utilisation, but
    - even when MS responses to supplements were high (120 g MS/kg Palm Kernel; PKE) and PKE was relatively inexpensive ($245/t), the cost of the marginal MS was $6.28/kg MS. This means that unless MS price is more than $6.28/kg MS, the MS from PKE **COST** money to produce;
    - the marginal cost of the MS produced in the cropping farmlet was $7.22/kg MS; using crops to increase MS production from the farm must be carefully considered;
- These are only one year's data. The experiment will run for two more years and the collective results will be very valuable.

What do we mean by marginal economics?

In marginal economics, we attempt to measure the cost of producing an extra kg MS and compare this with the MS price. This is based on the principal that the increase in MS production associated with inputs is large to begin with, but gets smaller and eventually flattens with increasing inputs. For example,

- applying P fertiliser to very low Olsen P land will lead to a large increase in pasture production;
- however, the increase in pasture production declines as the Olsen P of the soil increases;
- applying P fertiliser to soil with above optimum Olsen P grows very little additional pasture.

This is the law of diminishing returns. Similarly, the first 100 kg of supplement provided to a cow results in greater marginal MS production than the second 100 kg, which is greater than the third 100 kg, and so on.

The danger in marginal analyses

There is a danger with marginal analyses; all the costs associated with system change may not be accounted for. For example, people often talk about the '***margin over feed***', which accounts for the milk production associated with supplementing the cow and the cost of the feed, but does not account for any other cost. Analyses of databases in New Zealand and in other countries have highlighted that many costs increase, with increasing use of non-pasture feeds (e.g., fuel and oil, labour, repairs and maintenance).

The experiment at NARF offers us a great opportunity to quantify some of those costs; for example, by keeping time budgets for people and machinery. Further costs that must be accounted for relate to milking more cows. Between 50 and 60% of the operating expenses on a dairy farm relate to each individual cow. Therefore, increasing the stocking rate leads to an increase in the majority of expenses/ha (e.g., animal health, breeding expenses, rearing costs, etc.). The costs associated with the increase in stocking rate must be accounted for in any evaluation of the system change.

Irrespective of the chosen farming system, it is important to understand the point at which further milk production is costing you more than the price you are receiving; in technical terms, this is the point at which the marginal cost of milk production (i.e., marginal cost) is greater than the milk price (i.e., marginal revenue; Figure 1).

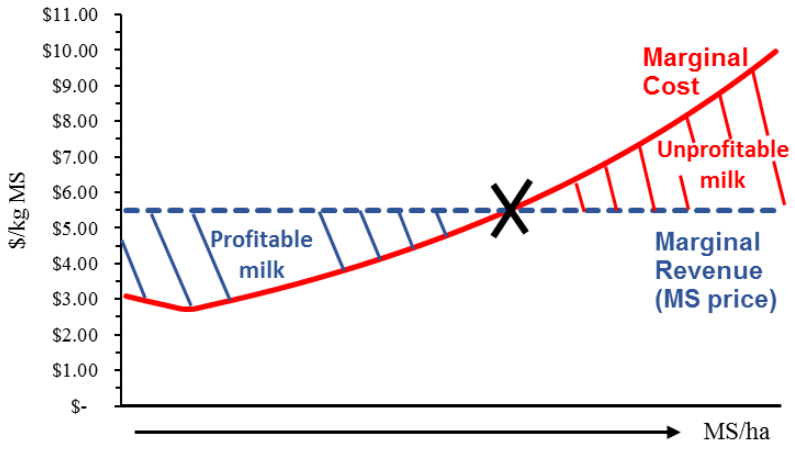

Figure 1. *The relationship between marginal cost and marginal revenue. When marginal cost is less than milk price (marginal revenue), profit/ha increases with greater production. When the marginal cost is greater than the marginal revenue, the increased production erodes farm profitability. In theory, profit increases with increasing MS/ha until marginal cost = marginal revenue (the X on the graph). In arguing about which system of farming is best, many people have lost sight of this basic economic principle.*

Differences between the farmlets

At NARF, we are examining differences in MS production between two self-contained farmlets and a third farmlet importing PKE to fill any shortfall in pasture production (PKE farmlet). The two self-contained farmlets are: 1) pasture only (Pasture farmlet), with surplus pasture conserved as silage and fed back when the herd is short of feed, and 2) a pasture farmlet with approximately ¼ of the farm being used to grow turnips, fodder beet, and maize silage (Cropping farmlet). The Pasture farmlet has a stocking rate of 2.5 cows/ha and the PKE and Cropping farmlet have stocking rates of 2.7 cows/ha. As well as MS production and feed use measurements, machinery use and labour hours/farmlet were recorded. By allocating costs appropriately, we can estimate the cost of the marginal milk produced on the PKE and cropping farmlets.

Results – milk production/ha

Milk production for Year 1 is presented in Figure 2.

- the Cropping farmlet produced 174 kg more MS/ha and 42 kg more MS/cow, and
- the PKE farmlet produced 159 kg more MS/ha and 36 kg more MS/cow

than the Pasture farmlet. This is a very high response to PKE (120 g MS/kg PKE delivered or 140 g MS/kg PKE DM purchased); in fact, this is 50% greater than the expected response to PKE and probably reflects the increase in stocking rate and the very strict decision rules the farm used for supplementary feeding in the experiment. A 0.23 cows/ha increase in stocking rate would be expected to increase MS production by 28 kg/ha. If the effect of stocking rate is removed, the average response to PKE was 100 g MS/kg DM PKE.

In addition, the results indicate that we can achieve as much additional production by growing crops for summer (i.e., turnips), autumn (fodder beet), and winter use (i.e., maize silage) as we did from buying PKE at the same stocking rate. Several years of results will be important to determine whether the milk production differences are consistent.

Results –marginal cost of extra milk produced

Based on farm working expenses (FWE), but with no allowance for depreciation or debt, the cost of production in the Pasture farmlet and the marginal cost of the additional milk production in the PKE and Cropping farmlets are also presented in Figure 2. The average cost of production was $3.59, $4.20, and $4.01/kg MS for the Pasture, Cropping, and PKE farmlets, respectively; this doesn't appear to be a large difference. However, the average cost of production hides the cost of producing the extra MS; on average,

- each kg of additional (i.e., marginal) milk on the Cropping farmlet cost **$7.22** to produce
- each kg of additional milk on the PKE farmlet cost **$6.28** to produce.

These results are consistent with analyses that we have undertaken on other experiments.

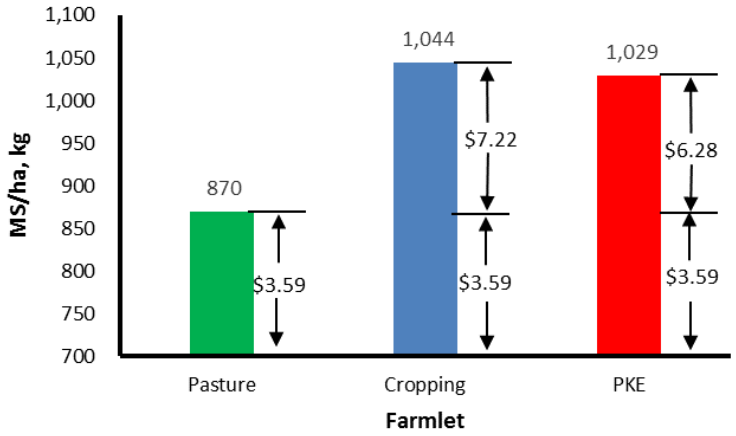

Figure 2. *Milksolids production/ha in the Pasture, Cropping, and PKE farmlets, the cost of production in the pasture farmlet, and the marginal cost of the additional milk produced in the Cropping and PKE farmlets.*

Difference between strategic and tactical use of purchased feed

There is a difference between the strategic and tactical use of feed.

The strategic use of feed is planned from the start of the year. For example, if someone increases stocking rate by 0.25 cows/ha, they will either plan to import 1 t DM supplement/ha (i.e., assumes a cow eats 5 t DM/year) or feed each cow less. In this scenario, the farm gets both the benefits and additional costs associated with the change to the system (e.g., greater milk production/ha, but greater herd replacement, animal health, and breeding expenses/ha). In farm system analyses, on average, the total increase in costs associated with the system changes needed to use purchased feeds is approximately 50% greater than the cost of feed. So, for example, if purchased feed is $1/kg MS, total costs will increase by approximately $1.50/kg MS, on average. It is this strategic response to imported feed that is being investigated at NARF.

This is different to the tactical use of feed. Tactical use of feed is where a farmer purchases 'unplanned' feed to minimise a short-term feed deficit (e.g., cold and wet August, dry February). In this situation, they don't capture the benefits of an increase in stocking rate, but they also do not incur many of the costs associated with change to the system. However, the total cost is greater than the marginal cost of the feed, because there is an increase in associated costs (e.g., labour, fuel and oil, repairs and maintenance, electricity, etc.). These costs are included in DairyNZ's *Supplement Price Calculator* (https://www.dairynz.co.nz/feed/feed-management-tools/supplement-price-calculator/), which will help calculate the value proposition of purchasing supplementary feeds in a range of situations.

It is important to distinguish between strategic and tactical use of feed when deciding to import feed. For example, the marginal milk production response to strategic system changes involving the purchase of supplementary feed at NARF is approximately 20% greater than the expected response to using supplementary feed in an unplanned feed deficit. Therefore, the milk production responses to PKE presented in the NARF research must be considered as responses to changes to the farm system and not just responses to the inclusion of PKE.

Conclusion

The average cost of milk production can be a misleading statistic in evaluating the cost/benefit of system change. It is important to focus on the marginal response, while accounting for all costs that will change to achieve the additional production. It is this metric that determines whether you are ***making money from milk, or making milk from money***.

It is important to distinguish between strategic (i.e., planned, proactive) and tactical (i.e., unplanned, reactive) use of supplementary feeds. The large responses to supplementary feed in the NARF experiment is a result of changes to the farm system and not just a response to purchased PKE.

This is only one year's data. The experiment will carry on for a further two years and will provide a great opportunity to evaluate the effect of system change in Northland.