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# The sheep farm as a business

### INTRODUCTION

This chapter is intended for veterinarians working as rural practitioners and servicing the grazing industries who wish to better understand the financial environment in which their clients operate their businesses. The objective of this chapter is to explain some of the economic tools used to describe and plan farm businesses and to provide some examples which illustrate their size, financial structure and economic constraints. In general, veterinarians do not have access to the details of their clients' business arrangements but, with some knowledge of industry norms, veterinarians can provide advice which includes consideration of the likely economic impact on the farm business. When veterinarians make recommendations which include accurate economic assessments, their credibility is enhanced and the client benefits from the sound and appropriate advice.

Advice is *economically sound* if the net financial benefit which arises from implementing the advice increases profit or decreases the risk of loss for the farm business. Such advice is not always easy to give, for it demands a proper appreciation of the whole farm system, not just the isolated component currently under investigation. For example, consider a farm in southern Australia on which a client's spring-born Merino weaners are dying during the summer from malnutrition as a consequence of their low body weights. The client could be advised to move the time of lambing to autumn or winter to ensure that the weaners are better grown before summer. While this advice is technically correct — earlier-born weaners will be bigger by summer — it is not the best advice that a veterinarian can give. An earlier lambing will also have the effect of decreasing the productivity of the ewes. The client, if he or she took the advice, might lose more money from the poorer productivity of the ewes than he or she gains in better weaner health. An economically sounder solution could be to institute handfeeding with high-energy supplements earlier before the weaners lose weight. Veterinary advice should take into consideration the effect of any changes on the economic structure of the business as a whole, not just a single component. The need to adopt a systems approach when advising changes in farm activities is discussed further in Chapter 3.

When making recommendations which involve substantial up-front costs, veterinarians often need to make judgements about the financial strength of a farm business, even though the details are usually not available to them. Not all farm businesses are sufficiently robust to sustain extra expenditure unless the financial benefits materialise quickly. When veterinarians do not know the financial position of the client's business, an awareness of the financial position of the 'average' farm can assist the development of recommendations. It may be wise to offer a range of options, so that the client can choose one which is *appropriate* for his or her current financial position.

For example, following the diagnosis of footrot on a property, the client may be correctly advised that the disease is sufficiently serious to warrant eradication. It may be that the same client is in a tenuous financial position with limited ability to fund any further capital expenditure or employ further labour. The lack of funds will reduce the chance of a successful eradication campaign; the extra expenditure may push the farm business over the brink of viability. It is of little solace to a producer to have achieved eradication of footrot after three years if the farm business is no longer financially viable. In such a case, appropriate advice would be to establish effective, low-cost control measures which limit the effect of the disease while an experienced financial adviser addresses the immediate financial problems which the producer is facing.

Advice which is economically inappropriate is unlikely to be adopted or, worse, may be adopted and contribute to a deteriorating financial situation. Producers are accustomed to receiving veterinary advice which they choose not to implement for economic reasons. In the case of dairy farmers, it has been shown that producers generally do not perceive their veterinarian as competent in farm finance or business management<sup>1,2</sup>, with implications, therefore, for compliance with veterinary recommendations. The same attitude is likely to be common amongst sheep producers. Producers continue to have trust in their veterinarian and to use veterinarian often means that the veterinarian's suggestions for managing a problem are ignored or highly modified by the producer. Producers do not necessarily doubt the science behind veterinary advice, but they may question its practicality for farm businesses.<sup>3</sup>

In order for veterinarians to give appropriate and effective advice, with an expectation of a high level of producer compliance, several elements are necessary. First, it is important that they understand the basic financial structure of farm businesses. This means having an appreciation of the economic operation of farms in general, even if information about the specific client is unavailable. Second, veterinarians need to understand the effects that particular management strategies have on the profitability of those businesses.<sup>4</sup> Third, it is often best to offer a range of options when advising clients, particularly if doing so without privileged insights into the client's financial affairs.

## SOME BASIC ACCOUNTING — FINANCIAL STATEMENTS

It is possible to gain useful insights into the soundness and profitability of a business by examining its financial statements. Two of the most useful and familiar statements for this purpose are the *Balance Sheet* and the *Profit and Loss Statement*. While most veterinarians in general practice will not have access to a client's financial statements it is still useful for veterinarians to be familiar with accounting terminology and the financial structure of farm businesses.

### Balance sheet (also known as the Statement of financial position)

The Balance Sheet is a list of the *assets* and the *liabilities* of the business. An asset is an item which is of value to the business — which could be sold to realise cash. Assets usually

enable the business to produce income or, in the case of cash, allow the purchase of incomeproducing items. Assets include buildings, tractors, livestock and cash in the bank. Assets can also include debts owed to the business. In veterinary practice, for example, clients who do not pay for veterinary services immediately but delay payment for some days or weeks are known as *debtors* of the business and constitute an asset of the business. Similarly, farmers waiting for their wool cheque from their wool-selling agency after the wool is sold have that agency as a debtor to the farm business.

In contrast, debts owed by the business are *liabilities*. In most businesses, loans to the business constitute the major liabilities, and these loans are usually made by banks or private individuals. These lenders are known as *creditors* of the business. In veterinary practice, suppliers of pharmaceuticals to the practice may wait up to 30 days or more for payment. After they have supplied the goods and while they are awaiting payment, they are *creditors* of the business.

In accountancy terms, the *business* rather than the *proprietor* owns the assets. The proprietor is one of the creditors or suppliers of funds to the business — along with the bank, the stock firm, relatives or anyone who has lent money to the business. The liability of the business to the proprietor has a special name — *equity*, or *owner's equity*. It represents the capital funds introduced to the business when the proprietor started it and so is often referred to on Balance Sheets as the owner's *capital account. Equity* is the farm owner's investment in the farm business.

By definition, on a Balance Sheet,

#### Assets = Liabilities + Equity

The Balance Sheet, therefore, is always in balance. The top part of the Balance Sheet (Table 2.1) lists and totals the assets of the business; the second part lists and totals the liabilities and the owner's equity. The two totals will always be equal.

The Balance Sheet demonstrates how much money the owners could realise if they sold all the assets and paid all the debts. It shows, therefore, the *financial position* of the owners in relation to the business *at any one point in time*. It does not reflect the profitability of the business, although inferences could be made (with knowledge of the likely productivity of their particular enterprise) about the *viability* of the business. The farm business is *viable* if it has the ability to service (pay interest on) its debts and still have some money left over to provide the farm family with living expenses. If it does not have that ability, its debts will increase and the owner's equity will decline.

A simple Balance Sheet is illustrated in Table 2.1. The farm business had, at July 2017, assets worth a little over \$2.8m. Another way to say this is that 'the farm is worth \$2.8m'. The farm business has liabilities of \$120 000 — a loan from a relative, perhaps one whose share in the farm was purchased by the present proprietors but who was not paid in full, preferring to be paid interest by the farm business. The other 'loan' is a bank account that has an overdraft facility but is currently not overdrawn and that has, therefore, a zero balance.

By definition, the remainder of the value of the farm business belongs to the two proprietors of the business — the farm owners. If the farm assets are truly valued at current market values, then the farm could be sold and all debts (\$120 000) paid; and the proprietors would keep the rest of the proceeds. This amount (\$2 688 500) is their *equity* in the business. Equity is

Table 2.1: Balance sheet for a sheep farm business.

Balance Sheet	
July 1 2009	
J Smith and Son	
ASSETS	
Farm land and improvements	2,500,000
Plant and equipment	148,000
Livestock	160,000
Bank account	500
TOTAL ASSETS	2,808,500
LIABILITIES	
Loan from SA Smith	120,000
Overdraft at bank	0
TOTAL LIABILITIES	120,000
EQUITY	
Capital account J Smith	1,344,250
Capital account J Smith Jnr	1,344,250
TOTAL EQUITY	2,688,500
Liabilities plus Equity	2,808,500

sometimes expressed as a percentage of the total assets. These proprietors have 2 688 500  $\div$  2 808 500  $\times$  100 = 95.7% equity in their farm business.

Although it is not shown on the Balance Sheet, we can expect that the business has to pay interest on its debts. The level of indebtedness will vary through the year but, if \$140 000 were the average debt, the interest bill might be around \$7000 per annum, depending on the interest rate. This amount of interest will show on the Profit and Loss Statement, because interest is one of the expenses of the business. On some farms, equity is very low and farm debts are very high. In such cases the interest bill may be so high as to cripple the business because it cannot generate enough income to pay the interest. A business which cannot pay the interest on its loans without further borrowings is not viable.

### Profit and Loss Statement (also known as the Income statement)

The Profit and Loss Statement reveals the revenue earned and the expenses incurred in the operation of the farm business over a defined period — usually a financial year but sometimes a shorter period. Revenue earned on-farm normally comes from the sale of produce (wool, meat, livestock, milk, grain, etc.) and expenses are those monies spent on products completely consumed in the production process (shearing, drench, fuel, etc.) rather than on assets with a much longer life (buildings, tractors, etc.) or family expenses unrelated to the farm production (clothes, groceries for the immediate family, school fees, fuel for the family car, etc.). In

Table 2.2 the Profit and Loss (P & L) Statement shows that the farm business made a profit in the 12 months to 30 June 2018 of \$241 502. There are several important points to notice in this statement.

### Different types of expense account

Each line in the statements relate to one item or *account*. The expense accounts in the P & L Statement can be classified into several categories. Payment of interest, for example, is a *financial* expense. A major distinction exists between *variable* and *fixed* expenses. The difference between these two categories is important in some forms of farm financial analyses, which will be discussed below. *Variable expenses* are those which vary with the size or intensity of the enterprise. Note the first seven expense accounts in the example shown in Table 2.2. If there were no sheep on the farm, these would have zero balances — that is, nothing would be spent on shearing, animal health, etc. These are examples of variable expenses because they would become bigger if the enterprise were to run more sheep. Other costs would not vary if there were more sheep; administrative costs, rates and taxes, insurance for fences and sheds, for

Table 2.2: Profit and Loss Statement for a sheep farm busin	iess.
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#### Profit and Loss Statement June 30 2018 J Smith and Son

REVEN	UE	
	Income from wool	243,339
	Income from livestock sales	322,962
	Bank interest	1,320
Total		567,621
EXPEN	SES	
	Shearing	67,000
	Animal health	36,000
	Supplementary feed	32,500
	Flock rams	21,000
	Wool and livestock freight & costs	27,500
	Livestock insurance	800
	Miscellaneous stock requisites	2,500
	Fertilizer	18,819
	Interest	7,000
	Rates & taxes	15,000
	Administration	12,000
	Farm insurance	9,000
	Repairs and maintenance	35,000
	Miscellaneous	18,000
	Depreciation	24,000
Total		326,119
PROFIT		241 503

example, would remain the same. These costs are *fixed* — they exist whether the paddocks are stocked, cropped or empty.

### Owner's labour

On this farm, the owners have supplied the main portion of the labour and management of the farm. The sum of \$241 502, therefore, represents the reward for their management and labour and provides a return on their equity (their financial investment in the farm business). If the two owners had paid themselves a proper 'wage' for their work on the farm the surplus would have been substantially smaller. Being owners rather than employees, funds which they withdraw from the business to spend on personal items are termed *drawings*, rather than wages.

### Return on capital

The total capital value of the farm is \$2 808 500. In order to estimate the value of their farm and farm business as an investment, the owners could allocate a value to their labour and management of, for example, \$100 000, leaving a surplus of \$141 502. That surplus, expressed as a percentage of the total capital value, represents a 5% rate of return.

### Return on equity

If the surplus is expressed as a percentage of their equity ( $$2\ 688\ 500$ ), the owners could consider that they have received a 5.2% return for their investment (their equity) in the farm business.

### Allocation of the profit

Assuming the family do not withdraw all of the profit for personal expenses, there is a surplus produced in the 2017-18 year which can be applied either to reinvestment in the farm infrastructure (a new piece of equipment, for example, or a new farm building) or to debt reduction. Either way, if spent wisely, the expenditure should increase the likelihood of future profits in the business. Alternatively, the family may choose to withdraw some of the profit for investment off-farm.

## Depreciation

Depreciation of the value of some assets is an *expense* of the farm business but is not a *cash expense*. It is an expense on paper only. It is good business practice to account for the decline in value of farm assets like tractors, shearing plant, etc., and this allowance for depreciation is deductible from taxable income. Nevertheless, in the example in Table 2.2, the net *farm cash income* is actually \$24 000 higher than the profit shown because the effect of the depreciation of assets will not be realised until the depreciated assets are sold.

## Cash flow

The business received interest as income but also paid interest as an expense. This fact reveals an important characteristic of *cash flow* on sheep farms. Income in sheep enterprises is largely derived from a few major events each year, such as shearing and sheep sales, which often occur

within just a few weeks or months of that year. When wool or sheep are sold, some short-term debts (such as bank overdrafts) are paid, while surplus cash is invested in term deposits (for three to six months, perhaps), and the farm business receives some interest from the invested funds. Core debt, such as farm mortgages or other long-term loans, is not repaid because some cash will be required for operating funds during the year. By the time shearing and sheep sales come around again, cash could be in short supply and the business may be operating with bank overdrafts again. One can see that, if farm debt were high, interest expenses could be so high that the interest bill would exceed the profit. When that happens, unless remedial action is taken, additional funds must be borrowed every year. The farm business can then fall with increasing speed into overwhelming indebtedness.

### FINANCIAL PERFORMANCE OF FARMS PRODUCING SHEEP

The types of farms running sheep in Australia cover a broad range, from those which are specialist wool or lamb producers to those with a mixture of several enterprises with sheep forming a small part of the whole farm business. The size of flocks also varies considerably. A commercial flock may consist of just a few hundred ewes to 20 000 or more.

A family-operated farm — still the most common type of farm business in Australia — might need to run 3000 or more ewes to provide a satisfactory income for the family, if sheep were the only farming enterprise on the farm.

The statements in Table 2.2 are an example of the financial statements for a familyoperated sheep farm of 7800 dry sheep equivalents (DSE<sup>a</sup>), running 3000 adult ewes on 800 hectares. Most ewes are mated to Merino rams but some are mated to meat-breed rams, producing first-cross slaughter lambs. Farm income is of the order of \$189 per ewe present, which includes wool from the ewes, ewe hoggets and lambs, as well as the sale of crossbred lambs, Merino wether weaners, cull ewe weaners and cast-for-age sheep. Fleece values of adult Merino sheep have generally ranged between \$30 and \$60 in the decade to 2018 and the sale price of lambs at slaughter age has ranged between \$80 and \$150. Many factors influence these values, but some knowledge of the approximate productive value of sheep is essential to the process of advising producers about health and management strategies. Note also that profit is, in this example, about \$30 per DSE but might be significantly less than that if the true value of family labour was included as a cost.

It is of interest to examine some financial statistics collected from lamb-producing farms across Australia. The following statistics for these farms, as discussed below and illustrated in Figure 2.1, are supplied by the Australian Bureau of Agricultural Resource Economics (ABARE).<sup>5</sup> Farm businesses reported here are those which derive a significant portion of their income from lamb sales by selling 200 or more lambs per year. Most such farms operate with a mixture of enterprises, including cropping and beef cattle.

In 2016-17, around 18 000 Australian farms sold more than 200 lambs for slaughter and nearly half of those sold more than 500 annually. About half of the total number of slaughter

a A dry sheep equivalent (DSE) refers to the nutritional requirements of one head of livestock compared to that of a non-reproductive adult sheep. A ewe is typically rated as 2.0 to 2.5 DSE. See Chapter 6 for further discussion.

lambs produced came from farms selling 500 to 2000 lambs annually. These farms also receive income from wool and, usually, other farming enterprises.

- The average *farm cash income* for such farms over the past decade has ranged between \$120 000 and \$265 000 (Figure 2.1). Farm cash income is defined as total cash receipts less total cash costs. Cash costs include interest payments, employed labour, fertiliser, repairs and maintenance, etc. Cash income has been highly variable over the past 20 years as a consequence of variation in seasonal conditions and in the price received at sale for lambs, adult sheep, wool, beef and crops.
- Average *farm business profit* defined as farm cash income adjusted for changes in the livestock and fodder inventories over the year, depreciation of assets and an imputed cost for unpaid family labour was \$141 000 in 2016-17.
- Farm business profit is strongly influenced by the level of indebtedness and therefore by the size of the annual interest bill. For example, a farm with a debt of \$500 000 borrowed at 6% will pay \$30 000 per year in interest.
- The average farm debt on lamb-producing farms in 2016-17 was estimated to be \$736 000. Most farms operators (around 60%) have 90% or greater equity in the farm business, but 12% are operating with equity below 70%.
- Interest payments have consumed between 6% and 10% of farm cash income on lambproducing farms over the decade to 2017.
- The average rate of return on total capital invested in farms has ranged between -1% and 5% over the past 20 years, but it fluctuates markedly between farms in response to the level of indebtedness, commodity prices, the mix of enterprises on each farm and the quality of management.



**Figure 2.1:** Average farm cash income from 1995-96 to 2016-17 (in 2017 dollars) for farm businesses selling more than 200 lambs per year lamb. Drawn by KA Abbott. Based on data from ABARE surveys, Department of Agriculture and Water Resources; see van Dijk, Frilay and Ashton (2018).<sup>5</sup>

On farms deriving a large proportion of income from wool, the levels of income and profit have largely followed the fluctuations in the wool price (Figure 2.2). Through the latter part of the 1980s the market price was held artificially high by the Reserve Price Scheme, but the floor price was dropped dramatically to 700 cents per kg clean in June 1990 before the price stabilisation scheme was abandoned completely in February 1991. Prices commenced recovery in May 1993, only to fall again from mid-1995.

Rapidly rising meat prices since around 2003 led to a substantial shift in emphasis in the Australian sheep industry, away from wool production and into meat production. There has, however, been a marked increase in the wool price since 2010, with prices for wool in 2018 higher than at any time since 1988 and, in US dollar terms, the highest ever received.

### Conclusions from financial measurements

Two points arise from these statistics. First, the figures produced from farm surveys reflect average farm performances. The performance of the best farms is substantially better than the worst. Some of the differences between farms can be attributed to sheep management strategies which are associated, directly or indirectly, with health and production plans. Veterinarians have a role in developing and implementing these plans and can, therefore, assist in turning loss-making farms into profit-making farms.

Second, one has to wonder why farmers would tolerate low incomes and low returns on equity during periods of sustained low commodity prices. Some part of the answer lies in the choice of lifestyle and in the fulfilment of family tradition but, from a purely financial point of view, farms have represented a good investment over the long term because of *capital* 



**Figure 2.2:** Wool price reflected by the eastern market indicator (EMI), in nominal terms, from 1988 to 2017. The EMI is a commonly used index of wool price, related to the price received per kg for an 'average' fleece, on a clean-wool basis. Source: KA Abbott.

*growth* — that is, increase in the value of farms over time has proceeded faster than inflation. Provided that equity is high and farm business profits are on average positive, farms do represent a good investment in the long term. Consistently achieving positive business profit in the sheep and beef industries, however, increasingly demands high standards of management.

## ECONOMIC ANALYSIS OF ENTERPRISES AND STRATEGIES

The previously discussed statements, the Balance Sheet and the P & L Statement, are useful documents in that they are readily available and they give a broad overview of the state of health of a business. They suffer from the drawback that they are prepared primarily for taxation purposes rather than as aids to identification of problem areas in the business structure or in its performance.

Consequently, other economic tools have been developed to provide insights into farm businesses and as an aid to farm planning. The two most commonly used tools are *gross margin analysis* and *partial budgeting* but there is a range of other, more sophisticated techniques available, including *linear programming* and whole-farm economic modelling. A recent example of the latter technique is provided by van der Voort et al. (2017).<sup>6</sup>

## Partial budgeting

A *budget* is a statement of expected income and expenses for a period of time in the future. In a *partial budget*, two or more alternative plans are compared with budgets which show only the extra expenses and extra income associated with each alternative. The budget is *partial* because only items which are relevant to the proposal are shown. It is a common procedure for evaluating veterinary intervention in grazing enterprises, such as improvements in worm control which might be achieved by altering the frequency of anthelmintic treatment, for example, or by examining the costs and benefits of a proposed vaccination programme.

## Gross margin analysis (GMA)

A gross margin is the difference (the margin) between gross income and variable costs. In a gross margin analysis, the gross margins of particular farm activities (for example, wool from a wether flock, wool and lamb production from a prime lamb flock, vealer production from a beef herd, wheat grown from a cropped paddock) are calculated and compared in order to assist in farm-planning decisions. GMA ignores fixed and financial costs because these are unique to each individual farm and each farm business and do not usually affect the financial merits of the enterprise under review.

*Gross income* is the value of the total production from the enterprise for the period of time under analysis. It is not the same as total income for the period, for it does not include products sold in the analysis period which were produced outside the analysis period, but it does include products arising in the analysis period which remain unsold at the end of the period.

*Variable costs* are the expenses incurred for resources consumed during the analysis period *which vary with the intensity of the activity.* They are also called *direct costs*, because they are costs which can be attributed directly to the operation of the enterprise, rather than the costs which occur whatever enterprise is run.

The P & L Statement from Table 2.2 can be used to calculate a gross margin for the farm of J Smith & Son (Table 2.3). This farm runs sheep on 800 ha and has 7800 dry sheep equivalents

**Table 2.3:** A gross margin analysis for the 7800 DSE Merino sheep flock of J Smith and Son, running on 800 hectares. The flock includes 3000 medium-wool Merino ewes, some of which are joined to Merino rams and some joined to a terminal sire for crossbred lamb production.

	J Smith and Son		
GROSS	NCOME		
	Income from wool		243,339
	Income from livestock sales		322,962
Total			566,301
VARIABL	E EXPENSES		
	Shearing		67,000
	Animal health		36,000
	Supplementary feed		32,500
	Flock rams		21,000
	Wool and livestock freight & costs		27,500
	Livestock insurance		800
	Miscellaneous stock requisites		2,500
Total			187,300
GROSS	MARGIN		379,001
Gross ma	argin per hectare	s	474
Gross ma	argin per DSE	\$	49

### Gross Margin Analysis

(DSE). In comparing farm activities, it is usually necessary to compare gross margins relative to another resource. Gross margins are frequently quoted on a *per hectare* (GM/ha) basis, so the gross margin for the sheep enterprise is \$474 per hectare. Occasionally, gross margins are quoted on a *per-head* or *per-DSE* basis. These references are usually less useful because stock numbers are rarely the *limiting resource* for graziers; but land area and capital funds are. Gross margin per head is *not* constant with stocking rate, nor is gross margin per hectare. Producers are much more likely to wish to maximise gross margin per hectare than gross margin per DSE, and the two maximum points rarely occur at the same stocking rate.

Note that the gross margin is not the same as profit. Profit in the above example could be calculated by subtracting fixed and financial costs from the gross margin.

### The application of gross margin analysis

Gross margins are used particularly for two purposes.

- 1. For farm planning:
  - This process involves comparing alternative management strategies for the operation of an enterprise for example, to compare the gross margin likely to be achieved

from a Merino flock keeping wethers to two years of age, rather than selling them as weaners.

- This process involves comparing alternative enterprises within the one farm business; for example, to compare the gross margin achievable from a Merino flock to that from a beef herd. Frequently, such comparisons lead to changes in the relative scale of enterprises on the farm. While wool prices remained low in the first decade of this century, many graziers have scaled down their Merino flocks and scaled up their prime lamb flocks, their beef herds and their cropping operations, all of which had similar or higher gross margins than Merino flocks in many districts.
- 2. For farm analysis:
  - Gross margin analysis can be used to highlight inefficient practices in the operation of farm activities, particularly by comparing details of the analysis to a *district standard* or to other farms in the district (an inter-farm comparison).

There are a number of limitations to the application of GMA for these purposes but, provided care is exercised, the process can be particularly useful. The advantage of GMA is that fixed, financial, personal and tax expenses can be ignored in the analysis. While these expenses can vary markedly between farms, they are difficult to allocate to parts of farms or specific enterprises within farms. In any case, those expenses are unaffected by the operation of any of the possible enterprises and are therefore irrelevant to the comparisons.

One of the frequent criticisms of the GMA technique is that it fails to properly account for differences in the requirements for capital resources, particularly capital funds and labour, between different enterprises. Other criticisms include the technique's failure to account for longer-run effects of different enterprises, complementarity between enterprises on farm, and taxation and cash-flow implications involved in different enterprises.

Some expenses are difficult to describe as completely fixed or completely variable. For example, should fertiliser and pasture renovation be considered variable expenses? Labour is also difficult to allocate, partly because it behaves economically in a *lumpy* or *step-wise* fashion. If labour is a slack resource (under-utilised), a more labour-intensive enterprise may not increase expenditure on labour. At some level of labour utilisation, however, increases in intensity will add a quantum amount to labour expenses.

### Modified gross margin analysis

It is possible to overcome some of the principal weaknesses in GMA for evaluation of alternative sheep or cattle management plans by making allowance for changes in requirements for capital and labour. Whereas it would not be correct to include changes in required capital as either an expense or source of income, we could allow for the *opportunity cost* of the capital required.

## Opportunity cost

This is effectively the income forgone by investment of capital funds into a particular activity. In many cases, opportunity cost is equivalent to the interest foregone by not investing in an alternative money-making scheme, or simply the cost of bank overdraft interest if additional funds are provided by a bank loan. The major changes in capital often relate to the size of the

**Table 2.4:** A modified gross margin analysis of a 2600 DSE Merino ewe enterprise, for comparison to Table 2.5.

	1000 ewe sheep enterprise	
GROSS	INCOME	
	Income from wool	80,000
	Income from livestock sales	110,000
Total		190,000
VARIA	BLE EXPENSES	
	Shearing	22,000
	Animal health	12,000
	Supplementary feed	11,000
	Flock rams	7,000
	Wool and livestock freight & costs	9,000
	Livestock insurance	250
	Miscellaneous stock requisites	900
	Opportunity cost, livestock	7,200
	Labour (imputed value)	30,000
Total		 99,350
GROSS	MARGIN	90,650
Gross n	nargin per hectare	\$ 363
Gross n	nargin per DSE	\$ 35

Gross Margin Budget				
1000 ewe sheep	enterprise			

flock or herd, so we can introduce the opportunity cost of the value of the stock as an extra expense when comparing plans with different numbers or types of livestock. The capital can be recouped by selling the livestock at some time in the future, if desired, but in the meantime there is income foregone from alternative uses of the money invested in the livestock.

Accounting for labour expenses in GMA can be done by allocating a particular value to the cost of labour per head or per DSE. For example, in the modified GMA of the J Smith and Son flock, the allocation of labour costs has been \$30 per ewe (Table 2.4). This is equivalent to saying that one labour unit costing \$90 000 per year can manage a 3000-ewe flock single-handedly.

#### Using a modified gross margin analysis to compare enterprises

Let's assume the Smith family have purchased an additional 250 ha property adjacent to their existing farm. They are considering either an expansion of their current sheep enterprise or a beef cattle enterprise. In either case, the extra livestock will need to be purchased. They can buy 1000 Merino ewes for \$120 each or 175 cows at \$1500 per head. Once stocked, and with young stock on the property as well, those numbers represent the same grazing pressure — about 2600 dry sheep equivalents. One of the factors which attracts the Smiths to a cattle enterprise is their lesser requirement for labour per DSE compared to breeding ewes.

A normal gross margin analysis does not account for the differences in capital cost of livestock or the labour requirement of each enterprise, but a modification of the gross margin analysis technique can include those expenses (Tables 2.4 and 2.5).

The comparison of the gross margins for the two enterprises suggests that the Smiths would not be wise to replace their sheep flock with a cattle enterprise. The gross margins, however, are reasonably close, so the difference may be sensitive to assumptions which have been made about the prices received for produce, or the costs of livestock. A *sensitivity analysis*, exploring the effect of varying the assumptions, is likely to be worthwhile.

Note that the difference in the funds required to purchase the ewes (\$120 000) or the cows (\$255 000) has been included by allocating the opportunity cost of the capital at a value of 6% of the capital cost.

**Table 2.5:** Gross margin analysis of a 2600 DSE beef cow herd selling vealers, using a modification to account for the opportunity cost of capital expenditure and the imputed cost of labour. The gross margin is directly comparable to that in Table 2.4, because both are scaled to the same number of DSE, so both enterprises are expected to require the same amount of pasture area. Differences in labour requirement and capital investment required to buy cows have been accommodated as described for modified gross margin analysis.

#### Gross Margin Budget 170 cow beef enterprise

GROSS IN	COME	
2010	Income from sale of steers & heifers	106,000
	Income from sale of cfa bulls and cows	12,000
	Income from sale of culls	21,000
Total		139,000
VARIABLE	EXPENSES	
	Animal health	1,750
	Supplementary feed	3,938
	Replacement bulls	10,500
	Livestock freight and selling costs	10,150
	Livestock insurance	400
	Miscellaneous stock requisites	200
	Opportunity cost, livestock	15,750
	Labour (imputed value)	20,000
Total		62,688
GROSS M	ARGIN	76,313
Gross mar	gin per hectare	\$ 305
Gross man	gin per DSE	\$ 29

Even if the cattle enterprise appeared to be a better option, additional factors deserve consideration. These include any additional capital costs required for a switch to cattle production (for example, strengthened fencing and water troughs, cattle yards) and their own expertise in managing cattle. However, there may be complementarity between the two enterprises which favours the cattle enterprise — such as differences in the timing of major labour-intensive husbandry events, such as calving, calf marking, shearing, lambing, lamb marking, etc.

Gross margin calculations often contain more detail than given here. For example, income might detail the expected wool cut and wool price from ewes, wethers, hoggets and weaners. Similarly, income from cattle might show the relative contribution from sale of cows, finished vealers, store vealers and bulls. This enables some assessment of the degree of optimism or pessimism employed in the comparison. Details have been omitted here to avoid confusing the general application of GMA with the details, which vary from year to year.

Gross margin analysis is used at several points in later chapters of this book, particularly to evaluate procedures which involve major changes in the operation of the flock, such as alternative genotypes, changing reproductive rate and optimising stocking rate. One strategy we will discuss is the optimisation of flock structure, and we can use a GMA approach to come to general conclusions about the optimisation of flock composition and the *sensitivity* of the gross margin to alternative compositions. Computer models are frequently used for this purpose because the number of mathematical relationships requiring recalculation for a range of strategies can be tiresome if done by hand and calculator, particularly where the results are sensitive to small changes in a large number of variables, such as the decline in productivity of ewes and wethers with age. White<sup>3</sup> used a comparison of gross margins to evaluate change in the reproductive rate of sheep flocks and the gross margins were calculated by a computer model which considered a very large number of effects and interactions for a large set of environmental conditions.

GMA has also been used in veterinary fields to justify an increased level of veterinary services to dairy farms. A four-year controlled study of a dairy herd health programme conducted from the Melbourne University Veterinary School from 1973 to 1977 was evaluated in economic terms using a GMA.<sup>4</sup> Gross margins per hectare on farms using the herd health programme were increased by \$23, \$1, \$43 and \$68 in each of the four years, relative to surveillance farms which did not have herd health programmes. The method and the conclusions, however, were challenged by economists who argued, inter alia, that GMA was not the best method of analysing the results.<sup>5</sup> Johnstone et al.<sup>6</sup> used GMA in analysing a field experiment to show that suppressive treatment (11 per year) with anthelmintics was financially superior to preventive, curative and salvage treatment. While the result was correct, it has since been demonstrated that the suppressive treatment was not optimal, either — other untested strategies are now known to be better.

This report is a straightforward application of GMA for those readers interested in a simple illustration of the technique. It should be noted both that only a few income and expense items are used and that the results could equally well have been analysed with a partial budget. In other more recent studies, the impact of ovine Johne's disease on the gross margin of sheep flocks in Australia and the losses associated with bovine viral diarrhoea virus in a dairy herd in Europe were assessed using the technique of gross margin analysis.<sup>7,8</sup>

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