Learning objectives
On completion of this topic you should be able to:

- Identify the three key variables in the profit equation
- Understand the relationship between production per hectare and cost of production
- Understand the relative importance of drivers of lamb and wool production per hectare
- Understand the impact that timing of sales has on price received for lamb
- Understand how the timing of sales will impact on production per hectare and cost of production

Introduction
In broadacre farming businesses, the key resource limitation is land. Because land is so expensive it cannot easily be acquired to increase the scale of the business, and in addition there is a significant amount of fixed costs that come with owning and farming land which means that to generate an acceptable profit the land must be operating near its economic capacity. The economic capacity of the land will be that point at which additional spending within the area under management brings no higher return than that generated from buying additional area. Maximum profit per hectare is therefore the key objective in the operation of a sheep enterprise.

The three key variables of profit are shown in Figure 19.1. Profit per hectare equals the production per hectare multiplied by the difference between the price received per kilogram and the cost per kilogram of production. The best profit result is unlikely to be found where any one of these three variables is maximised because they are all interdependent and often have negative impacts on each other.

To set up a production system in the most profitable manner requires a detailed understanding of the impact any proposed change to improve one variable will have on the other variables of profit. Examples of the interdependence between these variables are:

- Obtaining more kilograms per hectare through supplementary feeding, however supplementary feeding costs have increased
- Increasing price per kilogram by targeting seasonal premiums, however productivity per hectare may fall in order to produce the lambs at that time of the year or additional supplementary feeding may be required, therefore increasing costs

Profitable producers think in per hectare terms and are conscious of all three variables in the profit equation for all products in the system (wool, lamb, and surplus sheep). Profitable producers also understand that per head production measures, such as weaning percentage, lamb weight at sale and sale price per head may be compromised for per hectare performance, and consider them secondary to per hectare measures.
For this topic a Prime lamb flock refers to a production system which is focused mainly on meat production. A Wool flock is a strictly wool producing flocks of either self-replacing Merino ewes or trading wethers. A Dual purpose flock is a non-specialist flock, dominated by Merino ewes joined to terminal sires but also includes dual purpose breeds.

13.1 Production

Understanding the pasture resource base

All production is dependent on feed available. Feed sources include pastures and supplements in the form of crops and stored fodder (grain, silage, hay). Pastures are the cheapest source of feed and therefore the most profitable production will occur with effective utilisation of pasture. As more supplements are added into the system the margins decrease and the working capital requirements increase. It is therefore important that a production system is designed to maximise utilisation of pastures before depending on supplements.

The two factors that affect pasture performance are availability and digestibility. Actively growing pastures have high digestibility, and it declines as pastures enter their reproductive stages and then finally senesce. Consequently, there is an inverse relationship between pasture availability and digestibility. Maximum production, or maximum energy availability, per hectare is only possible when neither of these factors are limiting for the chosen class of stock.

Figures 19.2, 19.3 and 19.4 show modelled average pasture availability for three sites in Australia where sheep production systems are common. The pasture curves were produced using Grassgro™ which utilises historical weather records to simulate pasture production. Each pasture curve shows the amount of green and dry feed available at any given time of the year. The majority of the sheepmeat production occurs in southern Mediterranean type environments where the pasture growing seasons extends from the autumn to spring or early summer. Alternatively, wool enterprises tend to dominate in the more northern summer dominant rainfall regions where green pasture is available for a longer period of the year with less of a difference between the times of the year where there is peak feed availability and minimum feed availability.

Figure 19.2 Dunkeld pasture availability curve (McEachern 2007).
Supplementary feeding

The margins between the price of lamb and wool and the cost of supplement are normally too low to run either enterprise totally dependent on supplements. For example, the 5-year average production of lamb per DSE from benchmarked prime lamb enterprises is 7.4 kg dressed weight. Using the rule of thumb that each DSE will require 3.5 kg of grain per week, it would take 182 kg of grain to produce the 7.4 kg of lamb. Assuming a kilogram of lamb is worth $5.00, the price of grain would have to be under $200 per tonne just to cover the cost of grain. In addition to the cost of grain, there are enterprise running costs and overheads and so the business quickly becomes unviable.

Pasture on the other hand is much cheaper to produce and therefore the economics of production are better with pasture. This leaves three possible uses for supplements in the production system:

- Feeding supplements tactically for short periods of time to fill feed gaps that will allow for higher stocking rates and consequently greater pasture utilisation i.e. through late autumn and early winter in a year with a late autumn break.
- Feeding supplements to avoid large economic losses as a result of pasture shortages in adverse seasonal conditions i.e. where drought conditions dictate that livestock must be fed or sold to avoid losses.
Feeding supplements to stock specifically for production purposes i.e. for weight gain of sale stock or increased liveweight of ewes at joining to increase ovulation rate. The cost at which a ration becomes unviable can be estimated using rules of thumb for the expected weight of grain consumed for every 1kg of liveweight gain in sheep. A feed conversion ratio of 7:1 can be used as a starting point but needs to be adjusted for quality of ration, age of sheep etc (Davis 2003).

The opportunities for supplementary feeding will fluctuate depending on the relative price between supplements and lamb or wool and during poor seasons the relative cost of supplements fed to ewes. However, the system cannot be set up to rely heavily on supplements because they will significantly reduce margins due to their higher relative costs.

**Variation in production per hectare**

**Meat sheep**

The key product of meat sheep enterprises is lamb, which accounts for approximately 80% of enterprise income in prime lamb flocks, and 60% in dual purpose flocks. There is significant variation in production of lamb per hectare amongst specialist prime lamb enterprises and dual purpose enterprises as shown in Table 19.1. The bottom 20%, average and top 20% are ranked on profit per DSE.

While the differences appear small (5-7 kg/ha/100mm), when multiplied by the rainfall of enterprises receiving between 600-950 mm, they can amass to a difference of 30-65 kg of lamb produced per hectare. At a price of $5.00 per kilogram dressed weight the difference in lamb income per hectare is $150-$325. Provided the cost of achieving the additional production is not too high, the production per hectare is therefore a significant driver of differences in profitability through its impact on gross income.

**Table 19.1** Production of lamb per hectare per 100 mm for specialist prime lamb and dual purpose enterprises (Holmes Sackett Pty Ltd 2013)

<table>
<thead>
<tr>
<th>Production (kg lamb Dwt/Ha/100mm)</th>
<th>Bottom 20%</th>
<th>Average</th>
<th>Top 20%</th>
<th>5-year average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime lamb</td>
<td>12.1</td>
<td>17.7</td>
<td>19.1</td>
<td>14.3</td>
</tr>
<tr>
<td>Dual purpose</td>
<td>8.3</td>
<td>11.4</td>
<td>13.9</td>
<td>11.0</td>
</tr>
</tbody>
</table>

**Wool**

The key product of wool enterprises is wool, which accounts for approximately 65% of enterprise income. Unlike meat sheep enterprises, differences in production are not large between the least and most profitable wool enterprises. The 2012/13 there was a 1 kg decrease in the production per hectare per 100 mm between the average and the top 20% (Table 19.2). This result is slightly exaggerated by the rainfall patterns across the different performance bands in the 2012/13 year. Over the long term there is usually only a slight increase (0.2 kg) in wool production per hectare per 100mm. Nevertheless this suggests that either cost of production or price received, the remaining components of the profitability equation, are comparatively more important determinants of wool enterprise profitability.

**Table 19.2** Production of wool per hectare per 100 mm for specialist wool and dual purpose enterprises (Holmes Sackett Pty Ltd 2013)

<table>
<thead>
<tr>
<th>Clean fleece weight (kg/ha/100mm)</th>
<th>Bottom 20%</th>
<th>Average</th>
<th>Top 20%</th>
<th>5-year average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wool</td>
<td>5.3</td>
<td>5.7</td>
<td>4.7</td>
<td>4.1</td>
</tr>
</tbody>
</table>

**Key drivers of production in sheepmeat enterprises**

Production of lamb per hectare in sheepmeat enterprises is determined by:

- The number of ewes joined per hectare
- The number of lambs that are produced per ewe joined
- The weight at sale of lambs and ewes

**Ewes joined per hectare**

Ewe nutritional requirements vary throughout the year depending on which stage of the reproduction cycle they are in (Figure 19.5).
The requirements of a ewe through lactation to maintain her bodyweight and produce milk for the lamb at the same time are in excess of three times the requirements of the ewe in a non-pregnant physiological state. These requirements must be met with either pasture, supplement or through the utilisation of the ewes fat reserves. Supplements are more expensive and therefore give lower margins than pasture. Ewe fat reserves will be limited, especially if there are high ewe numbers per hectare.

Timing of lambing therefore has a significant impact on the number of ewes run. This is because each ewe would require three times the area, or pasture availability, during lactation than she did prior to lambing. To maximise the number of ewes that can be run on pasture without increased supplement costs, lactation needs to be at a time when pasture growth rates are at their highest. For most sheepmeat production areas this is late winter at the earliest through to early summer at the latest, however this is dependent on the location of the farm.

**Number of lambs weaned per ewe**

The number of lambs born per ewe is influenced by both genetics and nutrition. The nutritional component is mostly a factor of ewe weight (or condition score) at joining, but also the availability of nutrition leading up to lambing which will influence lamb survival through its impact on birthweight (Morley et al. 1978, Killeen 1967, Lifetime Wool 2004, Holst et al. 1986). It has been shown that some ewes respond better to higher liveweight at joining than others, but the response declines substantially when the ewe is in condition score 3.5 or better. It is estimated that there will be one to four additional lambs conceived per 100 ewes per additional kilogram of liveweight at joining under condition score 3.5. Most of these additional lambs will be the result of twin ovulations for which 75% survival to weaning is expected (Fogarty et al. 2005). Therefore, assuming that the response to increasing ewe joining liveweight is at the upper limits (4% increase in conception per kilogram), we can expect up to 3% additional lambs for every additional 1 kg of liveweight once lamb mortality is taken into account.

The costs in attaining liveweight gain prior to joining could include the cost of supplement or the cost of lower stocking rates. In addition there are costs of running more twin bearing ewes through winter rather than single bearing ewes. Twin bearing ewes require more feed and therefore more pasture area (lower stocking rate) or more supplementation. These costs need to be considered and calculated before nutritional gains in fertility are targeted to ensure that there is a profit obtained from adopting that strategy.

There are also significant genetic differences in the number of lambs born per ewe at any given level of nutrition. As for the nutrition based benefits, the genetic benefits of additional fertility come at an additional cost. As twin bearing ewes require more pasture or supplement than single bearing ewes there will be a cost associated with additional feeding of these ewes. Autumn and winter lambing production systems will pay a higher cost in either supplement or stocking rate adjustments than a spring lambing system would because feed is less limiting in the spring. The Maternal Central Progeny

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**Figure 19.5** Relative energy requirements of ewes throughout the reproductive cycle (McEachern 2007).
Tests showed ewes with higher genetic fertility, both within and between breeds, are significantly more profitable than ewes with lower genetic fertility (Fogarty et al. 2005).

The comparatively large pool of Merino ewes in Australia and the use of crossbreeding and terminal sires in sheepmeat production means heterosis also plays an important part in lamb survival through its influence on birthweight which alone may add 12-50% additional weight per ewe joined (Clarke 1982, Fogarty et. al. 1984).

There are also seasonal effects on fertility, with some breeds having more defined breeding seasons than others. The optimum time for joining in breeds with defined breeding seasons is the autumn. However, at high stocking rates ewe condition is likely to have been falling from summer into the autumn as pasture availability and digestibility declines and therefore there is a compromise with weight at joining and season of joining. To maximise the number of lambs weaned per ewe it would therefore be best to join when ewes are likely to have high condition score without the need for supplementation, at the end of the spring, and lamb when there is ample pasture at the start of spring. As the gestation period for sheep is only five months it is impossible to do both.

**Weight at sale**
The weight of lambs at sale is determined by the age at which lambs are sold and the growth rate to sale. Growth rate in turn is largely dependent on pasture availability, pasture digestibility, and genetics.

**Pasture availability and digestibility**
Table 19.3 shows the required combination of pasture digestibility and pasture availability to meet lamb growth rate targets. High lamb growth rates (>250g/day) on pasture alone are not possible once pastures have reached flowering in the spring. These growth rates are also not possible if there is less than 1600kg green dry matter per hectare in the winter. Because pasture availability and digestibility change throughout the year, with only a short period of time through spring where both are at their optimum, there will be a compromise between age at sale and growth rate to sale if the producer is trying to avoid using higher cost supplements to provide out of season feed.

<table>
<thead>
<tr>
<th>Growth rate</th>
<th>Active pasture growth (green)</th>
<th>Late Vegetative to early flowering (green)</th>
<th>Mid to late flowering (some dead)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125g/day</td>
<td>Digestibility 75%</td>
<td>1000kg</td>
<td>Np</td>
</tr>
<tr>
<td>175g/day</td>
<td>800kg</td>
<td>1700kg</td>
<td>Np</td>
</tr>
<tr>
<td>225g/day</td>
<td>1600kg</td>
<td>Np</td>
<td>Np</td>
</tr>
</tbody>
</table>

The bottom end of the domestic slaughter market requires lambs greater than 17 kg dressed weight which, allowing for a 46% dressing, requires lambs with a minimum liveweight of approximately 38kg. The time taken to reach this market is determined by the birth weight and the average weight gain. An ideal lamb birthweight would be approximately 4.5 kg which means that the lambs must gain 34 kg liveweight from birth to slaughter in order to reach a weight suitable for the domestic market. To allow for the time over which lambing occurs an additional 17 days (1 cycle) can be added onto the number of days required to allow lambs to reach their target weight. The time taken to get to the minimum market weight of 38 kg liveweight can therefore vary between three and a half to seven months depending on the growth rate achieved, which in turn will be dependent on pasture quantity and quality available for the ewes and lambs (Table 19.4).

As the chosen market weight increases the difficulty in sustaining a high growth rate also increases and therefore the time period to reach the target liveweight is likely to extend. The choice of market which is to be supplied, and therefore the target liveweight at sale, is the main driver of lambing date. The higher the target liveweight the longer it will take to reach it without supplement. The further the lambing date from the spring the less ewes that can be joined per hectare as lambing will occur at a time where pasture availability is limiting. Alternatively, the longer lambs are retained past the spring into summer and autumn to reach higher liveweights the fewer ewes that can be joined per hectare. This is because these lambs require grazing area which could otherwise be used for ewes that would produce a lamb at the end of the next spring.
Table 19.4 Time taken (months) to reach target liveweight at a given growth rate (McEachern, 2001).

<table>
<thead>
<tr>
<th>Growth rate (g/day)</th>
<th>Target liveweight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38</td>
</tr>
<tr>
<td>175</td>
<td>6.9</td>
</tr>
<tr>
<td>225</td>
<td>5.5</td>
</tr>
<tr>
<td>275</td>
<td>4.6</td>
</tr>
<tr>
<td>325</td>
<td>4.0</td>
</tr>
<tr>
<td>375</td>
<td>3.5</td>
</tr>
</tbody>
</table>

To ensure that taking lambs onto higher weights is profitable they must be sold when there is a significant premium for the additional weight gained, or when the price of supplementation is such that there is a marginal return from feeding.

**Genetics**

Genetics also has a significant influence on growth rate. There is considerable variation within sheep in relation to potential growth rate, the genetic component of which can be estimated using Lambplan™. For instance, the October 2013 percentile bands for the post weaning weight (weight corrected to 225 days of age) of terminal sires from the Lambplan™ database vary from -7.2 to 20.8. The latter ram is estimated to be genetically 28 kg heavier at 225 days of age than the former ram. This means the progeny of the high growth ram will be half this difference (14 kg) heavier at 225 days of age as half of the genes from the ram will be passed to the progeny.

These differences in genetic merit for growth do have a considerable impact on the profitability of the prime lamb production enterprise but as for fertility the benefits are not always free of cost. There is a positive correlation between growth rate and adult weight which means that progeny that grow faster are also likely to be larger animals requiring more pasture for maintenance as adults. In a self-replacing flock where the ewe progeny are retained as replacement breeders less ewes can be run per hectare if they have higher adult body weight. The manager needs to consider whether the increased growth rate will outweigh the loss in production from having less ewes.

Where high growth terminal sires are used, with all progeny being sold for slaughter the costs associated with the genetic improvement in growth rate is small. This is because the stocking rate effects are minimised as all progeny are sold for slaughter and the growth is ideally occurring at a time when feed is not limiting. The use of terminal sires with high genetic merit for growth may also allow heterosis to play a small part in improved weight at sale. It is estimated that heterosis contributes to a 0-6% improvement in weight of lamb turned off (Clarke 1982, Atkins et. al. 1981, McGuirk 1967).

**Key drivers of production in wool enterprises**

Stocking rate is a key determinant of wool production per hectare. Figure 19.6 shows the relationship between stocking rate and wool production per hectare per 100mm for the 2012/13 Holmes Sackett benchmarking data. Although increasing stocking rate reduces the energy available to individual sheep, the strong relationship between mid-winter stocking rate and wool production per hectare suggests that the compromise per head is not commensurate with the benefits per hectare.

![Figure 19.6 Wool production per hectare is strongly related to stocking rate (2012/13) (Holmes Sackett Pty Ltd 2013)](image_url)
Wool production per hectare is a function of average fleece weight and stocking rate. However, average fleece weight has a weak relationship, much weaker than stocking rate, with wool production per hectare per 100 mm (Figure 19.7). This is because average fleece weight is influenced by nutrition. Increasing stocking rate, which increases wool production per hectare, also reduces fleece weight through decreasing available nutrition. This suggests that there is more opportunity for producers to lift wool production per hectare through stocking rate than through increasing average fleece weight with nutrition. Average fleece weight is also influenced by genetics, however farm benchmarking data are not suitable for determining the influence of genetics on wool production through average fleece weight.

![Figure 19.7 Wool production per hectare is not strongly related to average fleece weight (2012/13) (Holmes Sackett Pty Ltd 2013)](image)

In wool enterprises, stocking rate is determined principally by time of lambing. Flocks that lamb outside the window of optimum pasture availability and digestibility are forced to run at lower stocking rates to ensure the energy requirements of the ewe are met without costly supplementation. Alternatively, flocks that lamb inside this window are run at higher stocking rates, and hence produce more wool per hectare.

### 13.2 Cost of production

Farm benchmarking shows a considerable range in cost of production of lamb ($/kg dwt) in sheepmeat flocks, and wool ($/kg cfw) in wool flocks, for the 2012/13 financial year (Table 19.5). There is over a $3 per kilogram difference in the cost of production of lamb in both prime lamb and dual purpose flocks. Similarly, there is almost a $6 per kilogram difference in the cost of production of wool in wool flocks. Understanding and lowering the cost of production can have significant impacts on the profitability of an enterprise.

#### Table 19.5 Cost of lamb production for prime lamb and dual purpose enterprises, and cost of wool production in wool enterprises (Holmes Sackett Pty Ltd 2013)

<table>
<thead>
<tr>
<th></th>
<th>Cost of Production ($/kg Dwt)</th>
<th>Price received</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bottom 20%</td>
<td>Average</td>
</tr>
<tr>
<td>Prime lamb</td>
<td>$6.46</td>
<td>$4.40</td>
</tr>
<tr>
<td>Dual Purpose</td>
<td>$5.31</td>
<td>$3.67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost of Production ($/kg Cfw)</th>
<th>Wool flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$12.05</td>
</tr>
</tbody>
</table>

#### Cost of production ratio

Cost of production is equal to the price received for a product at which the operating return on the assets invested would equal zero. Hence the cost of production ratio must include all costs associated with production. On any farm there are a combination of overhead costs and variable enterprise costs. Overhead costs are costs that are spread across all enterprises (i.e. labour and pasture costs) and variable costs are dependent on the number of sheep run or the number of lambs or amount of wool produced. Fixed costs are those that are independent of production per hectare (i.e. council rates).
Typically, 50-70% of the total costs on a farm are overheads. Approximately 30-50% of these overhead costs are labour and labour-related costs. Labour-related expenses may include fuel and lubricants, and machinery repairs and maintenance because these expenses are not incurred without labour. Consequently, only a small portion of overall expenses on a farm are actually fixed.

Assuming overhead and variable expenses do not rise disproportionately to productivity, increasing productivity will decrease cost of production. Table 19.6 shows one methodology by which cost of production may be calculated. In this example, the wool income is deducted from the total expenses to give the total cost of lamb production (net of wool income) which is then divided by the kilograms of lamb produced per hectare.

**Table 19.6: Methodology for calculating cost of production (McEachern, 2007).**

<table>
<thead>
<tr>
<th>Farm</th>
<th>Overhead costs ($)</th>
<th>Variable Costs ($)</th>
<th>Total Expenses ($)</th>
<th>Wool Income ($)</th>
<th>Lamb Production (kg Dwt/Ha)</th>
<th>Cost of Production ($/kg Dwt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$200</td>
<td>$130</td>
<td>$330</td>
<td>$75</td>
<td>50</td>
<td>$5.10</td>
</tr>
<tr>
<td>2</td>
<td>$200</td>
<td>$140</td>
<td>$340</td>
<td>$155</td>
<td>75</td>
<td>$2.47</td>
</tr>
<tr>
<td>3</td>
<td>$220</td>
<td>$170</td>
<td>$390</td>
<td>$155</td>
<td>90</td>
<td>$2.61</td>
</tr>
</tbody>
</table>

In the example shown, three farms with varying overhead costs, stocking rates, productivity and therefore different variable enterprise expenses end up with a very different cost of production from each other. Farm 2 has higher total expenses per hectare than Farm 1 but also has higher wool income and production per hectare and therefore ends up with a lower cost of production. Farm 3 has higher total expenses and higher lamb production than Farm 2 but the same amount of wool with a net result that the cost of production has increased rather than decreased. In this case the additional production has come at a net cost and therefore a premium in price will be required to make the system more profitable. The same methodology can be used to calculate wool cost of production.

The key message is that lowering cost of production is not necessarily about a reduction in costs, it can equally be about increasing production whilst expenses increase as well. So long as the value of production per hectare is increased by a proportionally bigger amount than the increase in costs the cost of production will fall. Increased production per hectare can therefore be a very powerful means of reducing the cost of production in a sheep enterprise.

**Cost control**

Cost control is also a very important part of profitable sheep enterprise, as is highlighted by the variation between benchmarked farms in both overhead costs and enterprise costs at any level of potential production.

**Overhead costs**

Figure 19.8 shows the overhead costs ($/ha) for prime lamb and wool flocks compared to long term average rainfall (mm). As rainfall increases, it is expected that farming intensity can increase and therefore the overhead cost structure of the farm may increase. Whilst this is the trend, at most given levels of long term average rainfall there can easily be $100/ha difference in the overhead costs per hectare.

Labour and labour-related expenses such as running costs for motor vehicles typically make up 30-50% of overhead costs which makes labour efficiency an important part of overhead cost control. Labour efficiency is most commonly measured as the number of DSE managed per labour unit. A labour unit is equivalent to 240 work days per year, and all days worked on a farm; owner/manager, family, contractor and shearing/crutching labour; is included in this measure of efficiency. Table 19.7 shows the variation in labour productivity in the 2012/13 financial year between the bottom 20%, average and top 20% of sheepmeat and wool enterprises ranked on net profit per DSE. The more profitable farms manage to run more sheep per labour unit than their counterparts.

Labour efficiency is aided by scale and simple production systems. Scale allows permanent labour to be spread over more DSE’s, and simple production systems lessen the demand on labour for any given level of production. Examples would be systems that avoid long periods of supplementary feeding or excessive handling of sheep.
Variable enterprise expenses

Enterprise expenses consist of those that are specifically related to the enterprise such as shearing and crutching, animal health costs, supplementary feeding, contract costs and selling costs. Some of these expenses are annual per head costs and consequently there will be a direct correlation between the number of sheep grazed per hectare and the enterprise expenses per hectare e.g. shearing. Others such as supplementary feeding or animal health costs vary depending on the management system and seasons.

The principal objective of additional expenditure per hectare is to increase the gross margin achieved per hectare, thereby increasing profit per hectare. The relationship between enterprise expenses per hectare and gross margin per hectare per 100mm of rainfall received for prime lamb and wool flocks in 2012/13 is shown in Figure 19.9. There is a general relationship between increased expenditure and increased gross margin however there is also substantial differences at any fixed level of expenditure in gross margin achieved. This highlights the importance of the production system used to increase productivity as there are considerable differences in the costs that may be incurred.

Variable costs cannot be ignored because at some point they will start to increase disproportionately to productivity and the marginal returns will start to decline. This will raise cost of production and decrease profitability.
Sheepmeat enterprises

Price received is an important component of any production system. The price received for lamb is dependent on:

- premiums or discounts for the market supplied
- the ability to get lambs to meet the required market specifications, thereby avoiding discounts
- the time of year that lambs are sold

Each will influence the average price received and therefore the profitability of the business. Table 19.8 shows the average price received per kilogram of lamb dressed weight in 2012/13 for the bottom 20%, the average, and the top 20%, ranked on net profit per DSE. These prices are inclusive of skin values. In both types of sheepmeat enterprises the top 20% achieved a slightly higher price received than the average, however the difference is only marginal, especially when compared to the difference in cost of production between the average and the top 20%. Thus, it is important that the manager realises that price is a relatively minor determinant of profitability.

Table 19.8: Price received per kilogram of lamb (Dwt) (Holmes Sackett Pty Ltd 2013)

<table>
<thead>
<tr>
<th></th>
<th>Bottom 20%</th>
<th>Average</th>
<th>Top 20%</th>
<th>5-year average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Lamb</td>
<td>$4.01</td>
<td>$4.35</td>
<td>$4.83</td>
<td>$4.95</td>
</tr>
<tr>
<td>Dual Purpose</td>
<td>$4.09</td>
<td>$4.16</td>
<td>$4.23</td>
<td>$5.06</td>
</tr>
</tbody>
</table>

The variation between markets and seasons is shown in Figure 19.8. There are two broad market classifications in Australia, the domestic and export markets. The domestic market will take lambs from 16-22kg dressed weight whilst the export market will take lambs from 20-30kg dressed weight. Figure 19.10 shows the average NLRS prices over the period 2002 to 2013, by month for 22-24kg export lambs and 18-20kg domestic weight lambs. Prices for lamb show far greater variation by month than by market. Over this period of time there has been only an average $0.01 difference in price received per kilogram between the two main markets. Domestic weight lambs do tend to have a premium price per kilogram through autumn and winter but conversely export weight lambs tend to be at a premium from early spring to summer. For both markets prices tend to peak in mid winter. At this time of year over the period analysed there has been a $0.50 to $0.60 per kilogram premium paid in July to the average of other months. The lowest price month is October.
The relativity of price between markets may change over time with changes in the demand and supply in each market. However, the seasonal premium for lamb in mid to late winter has been steadfast for a long period of time and is due to the low supply to the markets at that time. Should the manager decide to set up their production system to attain a seasonal premium in price they must be very conscious of the impact that will have on productivity and cost of production.

Figure 19.11 shows the difference in price received by month for the domestic and export markets for the 2012/13 financial year. From July to October there was little difference in price for domestic and export weight lambs, however from November through to June there was a $0.19 premium for export weight lambs. The difference in average price for July compared to the remainder of the year was $0.67, while the average difference between the two markets is $0.13, only 20% of the difference of the former. The difference therefore between the price received for the top 20% and the average for the 2012/13 year could be as a result of one or all of the following:

- Timing of sales
- Market supplied
- Number of lambs meeting specifications
Wool enterprises

Fibre diameter has been the key driver of price of wool over the long term, with the lower micron categories receiving large price premiums over the broader micron categories. Figure 19.12 shows the average price of wool from 2008-13 by micron category in the eastern states. As fibre diameter goes down, wool price received goes up. Fibre diameter, however, has an antagonistic relationship with average fleece weight. This means that some of the benefits of lowering a flock’s average fibre diameter are mitigated by lighter fleece weights. This negative effect on production can be somewhat overcome by running higher stocking rates. It is notable that although the price premiums for the lower microns have diminished in recent years, fibre diameter still remains the principal driver of wool price.

Figure 19.12 There is an inverse correlation between fibre diameter and average wool price received over the last five years (2008-13) (AWEX 2013).

Average fibre diameter of a flock is function of genetics and ewe nutrition. Within any given year, the effect of genetics on fibre diameter is fixed. The value of the genetics is determined by the fibre diameter to fleece weight ratio at any given level of nutrition. Alternatively, ewe nutrition, particularly energy, will affect average fibre diameter both within and across years. Increasing a ewe’s nutrition will increase her fibre diameter and fleece weight. Therefore consideration needs to be given to the increase in price against decreases in fleece weight where nutrition is constrained, and the opposite where nutrition is not constrained.

In the past staple length and strength have also been key determinants of wool price received. Twelve years ago, discounts of up to 50% and 25% were evident for fleeces with low staple lengths (46-50mm) and strengths (20-24 N/Ktx) respectively (Figure 19.13). However, like micron premiums, both of these discounts has been diminishing in recent years, to the extent that on today's market there is only a 5% discount both low staple length and strength.

Timing of sales also has a relatively large effect on wool price received, accounting for up to 10% of price variation throughout the year. Wool, unlike lamb, is a non-perishable, non-depreciating product. This means that wool can be stored and marketed independently of shearing date. Consequently, wool production systems do not need to be designed in order to achieve wools sales at any particular time of the year, and wool marketing is an off farm consideration. Alternatively, systems may be designed to better match the flock’s energy demand with pasture availability.
13.4 Setting up the production system – a lamb case study

The principal of setting up the most profitable lamb or wool focussed production system is largely the same. The manager must make a production plan that will achieve the optimum combination of price received, cost of production and productivity per hectare. It is the best combination of the three variables, not necessarily the maximum of any one.

In lamb production systems, the focus of this case study, there is little evidence of differences in price received between the different markets. Consequently the manager needs only to consider what season they will try to sell their lambs and at what weight. They must then calculate the expected cost of production and production per hectare for that sale period.

The three most common options would be to produce lambs for the late winter market, with an 11 year average price of $4.30, for the spring market with an 11 year average price of $3.50, or for the autumn market with a seven year average price of $3.90. Given overhead costs will remain relatively fixed no matter which market is chosen and that overhead costs are typically 50% of total costs then whilst ever supplementation is held to a minimum production per hectare is likely to be the greatest determinant of cost of production.

The three drivers of productivity are the number of ewes joined per hectare, number of lambs weaned per ewe, and weight at sale of the lambs. Figures 19.14, 19.15 and 19.16 show the strength of the relationship between these three variables and productivity for prime lamb enterprises. The same relationships hold true for dual purpose enterprises. Of the three key drivers of productivity, it is the number of ewes joined per hectare that has the greatest influence. There is a strong relationship between stocking rate and productivity whereas there are only very weak relationships between weight at sale and flock fertility and productivity.

This does not suggest that they are not important but rather that when considering the compromises between stocking rate, fertility and weight at sale the number of ewes grazed per hectare should be given precedence.
**Figure 19.14** Optimising the number of ewes joined per hectare should be a priority (Holmes Sackett Pty Ltd 2013)

**Figure 19.15** Increasing weight at sale is not a priority if the number of ewes per hectare has not been optimised (Holmes Sackett Pty Ltd 2013)

**Figure 19.16** Increasing flock fertility is not a priority if the number of ewes joined per hectare has not been optimised (Holmes Sackett Pty Ltd 2013)
Experimental work supports the finding from the benchmarking results. Below optimum stocking rates, the benefits from stocking rate increases outweigh any deleterious effects that increased stocking rate can have on the number of lambs born per ewe joined (Davis et al 1973, Donnelly 1984) or the weight at sale of lambs (Kenney et al 1974). It is important to reinforce the notion of optimum stocking rates because at some point in time as stocking rates increase, the cost of supplement and or the production losses will mean that cost of production starts to rise and margins will begin to fall. The benchmarking data highlights that many flocks may be below the optimum stocking rate for the production system they have. Alternatively they may have production systems that compromise stocking rate in pursuit of either higher weights at sale for a specific market or higher weaning percentages at a net cost to the profitability of the enterprise.

Given that optimum stocking rate is the most important variable of sales per hectare, production systems can then be worked out based on optimal stocking rates. An example of the impact that timing of sales will have on per hectare production is shown in Table 19.9. In this table there are two stocking rate limits, one in the autumn and one in the winter and the number of ewes that can be run per hectare is restricted to whichever limit is met first.

For simplicity the ewes have been given a DSE rating of three when lambing, 1.5 in late pregnancy, and one as a dry ewe. Gross sales for the production systems are calculated. The first production system is an autumn lambing system designed to turn off lambs into the late winter market where a premium price is received. The second system is a winter lambing system turning off lambs at the end of spring.

Table 19.9 Impact of timing of sales on per hectare production (McEachern 2013).

<table>
<thead>
<tr>
<th>Stocking Rate Limits</th>
<th>Autumn</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Lambing Time</td>
<td>Autumn</td>
<td>Winter</td>
</tr>
<tr>
<td>Autumn DSE Rating</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>Winter DSE Rating</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Number of Ewes per Hectare</td>
<td>4.3</td>
<td>5.0</td>
</tr>
<tr>
<td>NLW/EJ</td>
<td>100%</td>
<td>110%</td>
</tr>
<tr>
<td>NLW/Ha</td>
<td>4.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Weight at Sale</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Kg lamb/Ha (Lwt)</td>
<td>173</td>
<td>220</td>
</tr>
<tr>
<td>Kg lamb/Ha (Dwt@46%)</td>
<td>80</td>
<td>101</td>
</tr>
<tr>
<td>Wool cut per head (kg clean)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Wool cut per Ha (kg clean)</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Price received ($/kg lamb)</td>
<td>$4.30</td>
<td>$3.50</td>
</tr>
<tr>
<td>Price received ($/kg wool)</td>
<td>$3.50</td>
<td>$3.50</td>
</tr>
<tr>
<td>Total sales</td>
<td>$390</td>
<td>$406</td>
</tr>
</tbody>
</table>

The autumn lambing system can only run 4.3 ewes per hectare which have 100% lambs (due to joining out of season), and therefore produce 4.3 lambs per hectare at an average weight of 40kg. The winter lambing system can run five ewes per hectare with a 110% lambing due to joining closer to the optimum season and therefore produced 5.5 lambs per hectare. In both systems the ewes cut 3kg clean wool but in the winter lambing system there are more ewes per hectare and therefore a greater wool cut per hectare. The result is that the winter lambing system produces 21kg more lamb and 2kg more wool per hectare than the autumn system. Allowing for the premium in winter for lamb sales the winter system has $16 per hectare higher sales than the autumn system.

Total costs per hectare in the winter system will be higher because increased ewe numbers mean additional animal health, shearing costs etc. In addition there will be a greater loss per hectare in ewe depreciation as there are more ewes run per hectare. To make a decision on which system will be more profitable the relative gross margins need to be completed by adding in these costs.

Readings
Suggested readings include:
Revision Questions
1. What are the three key variables related to profit and how are they related? Provide sheep related examples of each variable.
2. How does cost of production differ between sheepmeat and wool enterprises?
3. What affects price received for sheepmeat and for wool and how can these be managed?
4. Discuss the importance of pastures to sheep enterprise profitability.

References


Holmes Sackett Pty Ltd. Data supplied by Holmes, Sackett and Associates 2012/13. Wagga Wagga, NSW.


