Dairy Sheep Manual

Farm Management Guidelines

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Foreword

This Dairy Sheep Manual was compiled as part of RIRDC Project, “Farming & Marketing Goat & Sheep Milk Products”. The Manual is intended as a guide to current recommended dairy sheep farm management practices based on observations and information gained during the course of the project. It is expected that the guidelines will be useful for both present and prospective dairy sheep farmers.

The project was funded from RIRDC Core Funds which are provided by the Australian Government.

This report, an addition to RIRDC’s diverse range of over 1800 research publications, forms part of our New Animal Products R&D program, which aims to accelerate the development of viable new animal industries.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- purchases at www.rirdc.gov.au/eshop

Peter O’Brien
Managing Director
Rural Industries Research and Development Corporation
Acknowledgments

This manual is based on a revision of the “Dairy Goat Manual”, produced by the authors in April, 2002, as part of RIRDC Project PTP-11A. Some of the sections in the manual are based on chapters from the “Dairy Goat Manual” with appropriate modification for dairy sheep. Other sections are based on texts listed under References.

The authors would like to particularly acknowledge the work of several previous researchers whose publications have been an invaluable reference. These include Stan Dawe and Geoff Duddy, NSW Agriculture; Roberta Bencini, University of WA; Graham Butcher, Rural Solutions, NZ; and Louise Gosling, Dairy Sheep Consultant, NZ. Grateful thanks are also extended to contributing author Roberta Bencini for her review and input to the manual drafts, and to Sandy and Julie Cameron, Meredith Dairy, for sharing their experiences in operating a successful, commercial dairy sheep enterprise.
# Contents

Foreword ............................................................................................................................................... iii  
Acknowledgments........................................................................................................................ iv  
Contents........................................................................................................................................... v  

1. Industry .............................................................................................................................................. 1  
   1.1 History & Prospects.................................................................................................................. 1  
   1.2 Markets..................................................................................................................................... 2  
   1.3 Farms......................................................................................................................................... 5  
   1.4 Annual Farm Check List .......................................................................................................... 8  

2. Breeding ........................................................................................................................................... 10  
   2.1 Breeds & Flock Selection....................................................................................................... 10  
   2.2 Mating Management............................................................................................................... 13  
   2.3 Lamb Rearing......................................................................................................................... 16  
   2.4 Flock Improvement .............................................................................................................. 21  

3. Feeding ............................................................................................................................................ 24  
   3.1 Nutritional Needs................................................................................................................... 24  
   3.2 Grazing Management............................................................................................................ 28  
   3.3 Weight & Condition Score Targets...................................................................................... 30  

4. Health .............................................................................................................................................. 33  
   4.1 Fly Strike & Soiled Wool......................................................................................................... 33  
   4.2 Lice.......................................................................................................................................... 34  
   4.3 Foot Problems....................................................................................................................... 34  
   4.4 Johnes Disease................................................................................................................... 36  
   4.5 Hypocalcaemia (milk fever)................................................................................................. 36  
   4.6 Pregnancy Toxaemia (sleepy sickness)............................................................................... 37  
   4.7 Hypomagnesia (grass tetany, grass staggers)..................................................................... 38  
   4.8 Clostridial diseases............................................................................................................. 38  
   4.9 Mastitis Control & SCC....................................................................................................... 38  
   4.10 Worm Control................................................................................................................... 42  

5. Milking ............................................................................................................................................. 45  
   5.1 Milking Premises Requirements......................................................................................... 45  
   5.2 Milking Shed Design........................................................................................................... 52  
   5.3 Milking Machines............................................................................................................... 55  
   5.4 Milking Management......................................................................................................... 62  
   5.5 Cleaning & Sanitising Equipment....................................................................................... 64  
   5.6 Antibiotics & Chemical Residues..................................................................................... 67  

References .......................................................................................................................................... 68
1. Industry

1.1 History & Prospects

The earliest recorded commercial scale sheep milking venture in Australia was in Victoria in the 1960s. This was followed in the 1970s by an on farm dairy and cheese factory in the Riverina area of New South Wales which led to wider interest and a surge of research and extension activity by NSW Agriculture in the 1980s through to the early 1990s. A manual was produced, newsletters were distributed, workshops were held and a national association was formed. Interest spread to other States, particularly Victoria which is now the main sheep dairying State.

The industry has waxed and waned since its beginnings and has had a high degree of failure due to unanticipated labour, management and capital requirements, low production levels and marketing problems. There have been an estimated 45 sheep milking operations started from the 1960s onwards but only about 8 are now functioning. This has resulted in inconsistency of supply from time to time which adversely affects consumer interest and market development.

Producers are now found in all States except New South Wales, milking around 4,000 sheep and producing about 500,000 litres annually, half of which is in Victoria. All but one producer also process their own product, more than half the output being yoghurt and nearly all the balance made into cheese. Products are marketed through farm shops, farmers markets, deliveries to specialty food stores and through distributors, according to each particular situation and size of operation.

Worldwide, commercial sheep milk production is currently nearly 10 million tonnes, more than half of which occurs in Mediterranean countries, the origin of the best dairy sheep breeds due to selection over many centuries. Cheese imports to Australia containing sheep milk, including pure sheep milk as well as mixtures of sheep, goat and cow milk, total around 2,000 tonnes per year, primarily due to the proportion of the Australian population of Mediterranean descent. This represents a huge potential market for Australian producers.

Domestic interest in Australian sheep milk products has been growing steadily, albeit erratically, since the 1960s and consumer demand generally exceeds supply according to trade sources. There has been solid growth in demand for sheep milk yoghurt in the marketplace via specialty food stores and supermarkets. Even more promising is the increasing interest in the European style specialty cheeses made from sheep milk such as feta, ricotta, haloumi and pecorino together with local types of fresh, white mould and blue cheeses. Smaller operators tend to concentrate on cheese production. Export opportunities do exist due to a world shortage of sheep milk products. However, such markets usually demand a regular supply of relatively large quantities of product. Any attempt to meet this international demand should be based initially on the establishment of a sound and cost effective domestic industry.

Industry organisation and information is virtually non-existent at present, however producers tend to liaise with each other. The Australian Specialist Cheesemakers’ Association (ASCA) includes sheep amongst other specialty cheeses and acts as a focal point for the industry. Research projects relevant to dairy sheep are mostly funded by the Rural Industries Research & Development Corporation.
Australian expertise in sheep farming, and also in mainstream dairying, is an advantage in the efficient production of sheep milk. Managing sheep for milk production is a much more intensive operation than managing for wool or meat. There is also a strong international market for disease free milking sheep, similar to that for dairy goats, which could eventually be supplied from Australia.

1.2 Markets

Product Advantages

Sheep milk products have numerous advantages over those from cow and goat milk including:

- Tolerance by some people who have allergenic reactions to cows milk.
- Up to 45% of fats are mono or polyunsaturated and therefore do not pose as high a risk to those concerned with health or heart disease.
- A high energy value.
- Higher solid non fat levels and a correspondingly greater yield for cheese production (20-25%) compared to goat (15%) or cow (9%).
- Beneficial human health properties associated with acidophilus yoghurt lines, improving gut flora balance and pH levels.
- The creamy mouth feel and sweet taste of unadulterated sheep milk reflects Australia’s Green and Clean image.

Products

Sheep milk can be processed into any dairy product by adding starter cultures, rennet for cheeses, and varying processing temperatures and maturation times. The fresher the product, the higher its yield per litre of milk, the faster the turnover and cash flow returns.

The current output of sheep milk is marketed almost entirely on the domestic market as yoghurt and cheese. Markets can be divided into gourmet and ethnic, the latter being strictly traditional and price conscious. Yoghurt comprises about 60% of the total production at this stage. All producers make cheeses of various styles from feta to mature hard cheeses similar to the classic Italian and Greek styles. There is little demand for sheep milk apart from limited sales through health food outlets. Sheep milk icecream has been produced in small amounts but such a product would never be more than a novelty item and could not compete in the general icecream market.
Yoghurt

Sheep milk yoghurt is quite popular with a small section of consumers. It is an attractive line for producers as it is relatively straightforward and quick to make, gives yields of 100% from milk and gives a quick return to assist cash flows. It has a limited shelf life of 21-28 days so consistency of supply is important, however it can be made from frozen milk.

Sheep milk yoghurt is distributed widely through specialty food stores and some supermarkets and currently retails for about $10 per kilogram. Demand is highest in the summer months which unfortunately occurs when sheep milk production is at its lowest level.

Cheese

This is considered the growth area in view of the range and volume of imported sheep milk cheeses on the market. Recent publicity given to Roquefort cheese, now allowed to be imported from France, has helped focus attention on sheep milk cheese. The imported Italian, Spanish and Greek styles of pecorino, manchego, haloumi and kefalogiri have been available for some time and mainly consumed by people from ethnic backgrounds. Australian producers have tended to concentrate on the fresher styles such as feta, white and blue moulds which are mature in two to four weeks and give reasonably quick income. The semi-hard to hard styles, typical of the imported cheeses, which need at least three months and sometimes more than twelve months maturing, are a minor proportion of local production but are gradually increasing in availability. Retail prices are highest for the blue cheese styles followed by washed rind, camembert, pecorino, haloumi and feta.

Main outlets are cheesemongers, delicatessens and specialty food stores. Sheep milk cheese is available much more widely than a few years ago, and this has occurred in the absence of specific paid advertising. Sheep milk cheese has also benefited from the interest in specialty cheeses, including promotional activities such as ASCA’s annual Specialty Cheese Show, but mostly from the food press. There is interest within the industry in the Australian Dairy Corporation’s role being expanded to include sheep milk products.

Affluent to middle income areas in the capital cities are the main outlets for Australian sheep milk cheeses. Prices paid range from $30-50 per kilogram for feta and $40-50 per kilogram for the other fresh styles. Imported feta ranges considerably in price from as low as $10 per kilogram but much of this type is not exclusively sheep milk but can include cow and goat milk as well. This does not appear to be of concern to the ethnic market, which is generally price conscious, as well as expecting traditional products. In some overseas areas use of different milks is quite acceptable. Other
Australian sheep milk cheese prices are comparable with imported styles but well below the price of the classic Roquefort which retails for up to $100 per kilogram. In contrast, some imported hard cheeses retail for as little as $20 per kilogram providing what is felt by the Australian industry to be unfair competition.

Competition from imports will continue. It may not impact on local growth very much but has the potential to put pressure on prices. Local product costs more to make than the retail price of some imports, even with a low A$. Scale is one reason for this, but there are also industry supports in Europe. The local industry needs to take full advantage of its strengths. In the past, local cheese quality and consistency have been described as poor but these do not seem to be major problems now. Customer expectations appear to have been met and some imports are even felt to be inferior to the local product.

**Lambs**

Sale of lambs, either as young 10-15 kilogram milk fed or suckling lambs or as 30-35 kilogram prime lambs, is a potential by-product of sheep dairying. The value and success of this activity depends on a number of factors, the first of which is having a ready outlet for the product and this would include proximity to slaughter facilities. In view of the fact that lambing is seasonal, a regular and consistent supply is hardly possible which is counter productive to profitable marketing.

There was a lucrative milk fed lamb export market to Italy in the late 1980s which failed due to irregular supply and incorrect shipping of carcasses. Nevertheless, such markets still exist including potential exports to the Middle East and Japan. There is also a domestic market for milk fed lambs through the ethnic population but the producer must source and supply the market and arrange for slaughter and transport.

Another issue is that rearing lambs, other than for replacement stock, takes the focus off the main enterprise which is milking sheep. This involves capital, labour and marketing costs which need to be covered by the returns from lamb sales. Lambs reared on their mothers for a time consume some milk which could have been converted into yoghurt or cheese.

However, recent research suggests that if lambs are fed by their mothers in a share milking system the extra stimulus from milking and suckling results in well grown lambs plus higher yields and longer lactations for the ewes. Other experience indicates that in this system there can be chaos separating lambs periodically and high producing ewes need lambs removed or they suffer udder/teat damage.

The fact that few sheep dairying enterprises bother with lamb sales is indicative that it is generally not a profitable sideline. Specialist lamb rearing businesses may have potential, as occurs in Europe.

**Wool**

An inevitable and necessary by-product of sheep farming is the annual wool clip. This is a very minor contributor to farm income in a sheep dairying enterprise due to the wool from sheep breeds used for milking being coarse and usually of lowest grade and price. The annual return from this by-product would be in the region of $30 per animal less shearing costs.
1.3 Farms

Considerations

Successful dairy sheep farms are operating on systems developed for cow dairying. Cow dairying models are generally useful and little adaptation has been necessary in areas such as grazing management, feeding systems and milking management. Thus a pre-requisite for dairy sheep farming is experience in sheep husbandry, pasture management and dairy management.

The general concept is to graze the dairy flock in paddocks in close proximity to the milking shed so that for the daily routine of milking, distance walked is minimal. A maximum distance of 500 metres is recommended. Dairy sheep are generally grazed on pasture and forage crops in Australia with some supplementary feeding in the bail or in the paddock according to season and need. Alternatively, housing or feed lotting can be considered. These systems have advantages in easier operation of milking and simplified feet care, worm and fly control, but have higher capital and operating costs.

Annual lambing is the norm, both to stimulate the natural, post lambing milk production of ewes and to breed replacements. The average production life of a dairy ewe is about five lactations.

Estimates of a viable flock size are difficult to make as it will depend on whether the operation is to be a sideline or a main enterprise and whether the milk is being on sold or processed on farm. In the latter scenario other activities such as farm shops and tourism income often cloud the viable size issue. Based on sales of milk off farm it would appear that a minimum milking flock size of 500 would be necessary. Production per head is usually over estimated and a realistic figure would be less than 1 litre per ewe per day. Current Australian averages are in the region of 125 litres/head/year with a wide variation between individual sheep. Production gains need to be made by both genetic improvement and management but flock size in numbers is as likely to remain significant as it is in mainstream dairying, and for the same reasons.

Regulation varies between States, with either the dairy authority or the health department licensing farms.

Milk prices are generally said to be in the region of $1.20-1.50 per litre. However, nearly all milk currently produced is processed on farm and not sold on to a factory. The possibility of developing an on-farm cheese and/or yoghurt factory should be carefully considered. There are some successful, high profile instances with high product recognition but factors such as set up costs, attainment or recruitment of processing skills, and establishment of market outlets have to be taken into account and all these take time and money. Potential outlets for milk should be explored by intending farmers and the size of the market quantified as far as possible. Manufacturers who express interest in taking milk may not have any idea of the amount that may be supplied, especially those outside Victoria and Tasmania. Local markets away from major metropolitan centres are very small.

Location

Farms should be located in productive fat lamb type country capable of supplying quality pasture feed for at least eight to nine months, to coincide with joining, lactation and late pregnancy, and as close as possible to milk processors and/or retail markets. A farm considered marginal for cow dairying may be suitable but the reasons for marginality should be carefully considered. Proximity to dairy services suppliers is an advantage both for equipment and ancillary services such as from veterinarians and milk testing laboratories.

The most suitable terrain is that which can be easily fenced, with laneways, arable, and sited such that the milking shed is the nucleus of the property. The milking shed needs to be alongside a made road or formed track to facilitate milk or product transport, particularly if milk is sold off farm.
A steep block is difficult to work although small bodied animals such as sheep may be physically able to graze the terrain without damaging it.

A small property is unlikely to be viable as returns per hectare need to be considered and the size of a viable flock, presently at least 500, is likely to increase. It has been suggested that a boutique operation, e.g. incorporating cheese making, alters these assumptions. However, observation of developing businesses suggests otherwise.

If milk has to be transported, distance from the processor or factory is important in terms of time and cost. It may be possible to have an arrangement with several farms and factories involved, rotating deliveries to offset costs. If the market is there, larger quantities of milk would offer more opportunities for other products and markets as well as for lower transport costs.

Intending farmers should reach a firm understanding with prospective outlets before proceeding. This is not easy and misjudgements can be made on both sides. Information should be sought as widely as possible, both within the general industry and in the local area. Local farmers’ markets away from major metropolitan centres are very small and generally do not live up to projections, and any tourism is usually seasonal.

**Layout**

A whole farm plan should be developed. TAFE and other education or extension services may offer courses or advice and a consultant may be used. Basic dairy farm considerations apply. For most purposes, six to eight dairy ewes can be considered equivalent to one dairy cow.

Attention should be paid to:

- *Ease of operation* - including pasture management, access of stock, machinery and people to all required areas, adequate drainage and water supply. Small paddocks, suitable fencing and well formed tracks are important for these reasons.
- *Herd health* - for example, location of lamb raising facilities away from effluent to prevent diseases.
- *Priorities* - most farms will not be able to implement all the aims at once. Those with the greatest economic impact will usually have to be addressed first.
- *Future development* - most operators have found their initial assumptions need revising upwards, even without basic industry parameters changing. Flexibility in the setup is important.
Fencing

Fencing for dairy sheep is not basically different from standard sheep farm fencing, however more substantial fencing may be required for some of the imported breeds. In any case, fences need to be well made and maintained. As with any livestock, sheep should be kept within good fencing from the start. It has been observed that although lambs may be active and jump fences, as adults they are much less likely to do so. Temperament and some culling may be the best option. Inherited temperament is a recognised issue in livestock. Fences need to be safe as well as a restraint, or injury and loss may occur.

Plain wire fences are suitable provided they are kept tightly strained and maintained. Ringlock or hingejoint is usual for boundary fences, laneways and sometimes for main internal fences. Four or five wire electric fences can be considered and are very effective for rationing grazing. Gates should be hung with small gaps only when closed. Yard fences are often made of mesh or sheep panels.

Detailed information on fencing is available from Departments of Agriculture and fencing stockists.
### 1.4 Annual Farm Check List

<table>
<thead>
<tr>
<th>Category</th>
<th>Task</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pastures</td>
<td>Soil Test</td>
<td>Spring</td>
</tr>
<tr>
<td></td>
<td>Fertilise with Phosphorus (P), etc.</td>
<td>Late Summer &amp;/or Spring</td>
</tr>
<tr>
<td></td>
<td>Apply Nitrogen (N)</td>
<td>From Autumn as needed</td>
</tr>
<tr>
<td></td>
<td>Close paddocks for Silage/Hay</td>
<td>Early Spring</td>
</tr>
<tr>
<td></td>
<td>Check for Weeds</td>
<td>Autumn &amp; Spring</td>
</tr>
<tr>
<td></td>
<td>Check for Insect damage</td>
<td>Autumn &amp; Spring</td>
</tr>
<tr>
<td></td>
<td>Oversow if required</td>
<td>Autumn</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vaccinations (Pulpy Kidney, Tetanus, Cheesy Gland)</td>
<td>Late Summer &amp; Late Winter</td>
</tr>
<tr>
<td></td>
<td>Worm Tests (Faecal Egg Counts)</td>
<td>Autumn, Winter, Spring &amp; Summer</td>
</tr>
<tr>
<td></td>
<td>Drenching</td>
<td>As required after worm tests</td>
</tr>
<tr>
<td></td>
<td>Drench Tests (Faecal Egg Counts)</td>
<td>As required after drenching</td>
</tr>
<tr>
<td></td>
<td>Udder Checks (Oedema, Mastitis)</td>
<td>Pre-lambing</td>
</tr>
<tr>
<td></td>
<td>Weighing</td>
<td>) Three times during lactation &amp; pre-lambing</td>
</tr>
<tr>
<td></td>
<td>Condition Scoring</td>
<td>According to seasonal conditions</td>
</tr>
<tr>
<td></td>
<td>Foot Baths</td>
<td>Ongoing &amp; according to veterinary advice</td>
</tr>
<tr>
<td></td>
<td>Disease Checks</td>
<td></td>
</tr>
<tr>
<td>Animal Health</td>
<td>Check Machines</td>
<td>Annually (Winter)</td>
</tr>
<tr>
<td></td>
<td>Check rubbers carefully for signs of wear and replace if any deterioration shows</td>
<td>Annually (Winter)</td>
</tr>
<tr>
<td></td>
<td>QA Check</td>
<td>Develop a program, eg, daily, weekly, monthly, annually</td>
</tr>
<tr>
<td>Dairy Shed</td>
<td>Weighing (to check growth)</td>
<td>Weekly ideally</td>
</tr>
<tr>
<td></td>
<td>Vaccination (Entero &amp; Tetanus)</td>
<td>5 weeks &amp; 9 weeks after birth</td>
</tr>
<tr>
<td></td>
<td>Weaning</td>
<td>At about 8 weeks or 16kg</td>
</tr>
<tr>
<td>Lamb Rearing</td>
<td>Yield Monitoring (bulk tank)</td>
<td>Daily ideally, or per delivery</td>
</tr>
<tr>
<td></td>
<td>Protein &amp; Fat Test (bulk tank)</td>
<td>Per delivery</td>
</tr>
<tr>
<td></td>
<td>Quality Tests (Food Safety) (bulk tank)</td>
<td>Per delivery</td>
</tr>
<tr>
<td></td>
<td>Testing (Milk volume, &amp; perhaps Protein, Fat, SCC, BMCC)</td>
<td>At least 3-4 times annually</td>
</tr>
<tr>
<td>Milk Production</td>
<td>Determine annual lambing pattern</td>
<td>A year in advance</td>
</tr>
<tr>
<td></td>
<td>Acquire rams or arrange for AI</td>
<td>6 months ahead of mating</td>
</tr>
<tr>
<td></td>
<td>Induce oestrus if required</td>
<td>6 months ahead of lambing pattern</td>
</tr>
<tr>
<td></td>
<td>Synchronise oestrus if required</td>
<td>6 months ahead of lambing pattern</td>
</tr>
<tr>
<td></td>
<td>Run rams with flock, hand mate or use AI</td>
<td>5 months ahead of lambing pattern</td>
</tr>
<tr>
<td></td>
<td>Pregnancy Testing</td>
<td>As required</td>
</tr>
<tr>
<td>Mating</td>
<td>Calculate Feed Requirements (Quantity &amp; Quality) for all stock</td>
<td>Annually, 6 months in advance</td>
</tr>
<tr>
<td></td>
<td>Estimate Pasture Production</td>
<td>Annually, and then Monthly</td>
</tr>
<tr>
<td></td>
<td>Prepare Feed Budget</td>
<td>Annually, and revise Quarterly</td>
</tr>
<tr>
<td>Feeding</td>
<td>Production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feeding</td>
<td>) Daily, Weekly, Monthly, Annually</td>
</tr>
<tr>
<td></td>
<td>Health</td>
<td>) as required by Notebook, Wall</td>
</tr>
<tr>
<td></td>
<td>Mating &amp; Lambing</td>
<td>) Chart, Planner, Computer</td>
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<tr>
<td></td>
<td>Paddocks</td>
<td></td>
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<tr>
<td></td>
<td>Financial</td>
<td></td>
</tr>
<tr>
<td>Records</td>
<td>Production</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Health</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mating &amp; Lambing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paddocks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Financial</td>
<td></td>
</tr>
</tbody>
</table>
Record keeping examples:

Annual Planner

<table>
<thead>
<tr>
<th>Season</th>
<th>Task</th>
</tr>
</thead>
</table>
| Autumn | Feed Budget, Worm Test, Milk Test  
|        | Mating  
|        | Weeds & Insects, Nitrogen, Oversowing |
| Winter | Feed Budget, Worm Test, Milk Test  
|        | Milking Machine checks  
|        | Vaccinations, Udder checks |
| Spring | Feed Budget, Worm Test, Milk Test  
|        | Soil Test, Fertiliser, Silage/Hay paddocks, Weeds & Insects  
|        | Vaccinate lambs, Review lambing pattern |
| Summer | Feed Budget, Worm Test, Milk Test  
|        | Vaccinations |

Production & Feeding Wall Chart

<table>
<thead>
<tr>
<th>Date</th>
<th>Ewes milked</th>
<th>Daily litres</th>
<th>Paddock &amp; area grazed (ha)</th>
<th>Est. Pasture DM intake (kg)</th>
<th>Hay/Silage fed (kg)</th>
<th>Bail Feed (g/ewe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15/09/01</td>
<td>480</td>
<td>540</td>
<td>12 - 0.25</td>
<td>450</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>16/09/01</td>
<td>490</td>
<td>530</td>
<td>&quot;</td>
<td>460</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>17/09/01</td>
<td>500</td>
<td>560</td>
<td>&quot;</td>
<td>460</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>18/09/01</td>
<td>510</td>
<td>580</td>
<td>9 – 0.30</td>
<td>480</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>

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2. Breeding

2.1 Breeds & Flock Selection

General Characteristics

The specific characteristic of a dairy breed of animal is length of lactation and this applies equally importantly to dairy sheep breeds. Breeds of sheep used for wool or meat production may produce adequate daily quantities and quality of milk post lambing for suckling lambs but have lactations well short of the 300 days expected of other dairy species. Short lactations may be compensated for by spreading lambing.

Some sheep breeds are more likely than others to produce considerable quantities of milk, eg, prime lamb breeds or the recognised dairy sheep breeds of the world. However, as with other species of dairy animals, there is as much genetic variation within a breed than between breeds. Therefore selection based purely on breed is not the final answer. Information from a long established flock seems to indicate that selection for productivity will be as successful as selection for breed.

World Breeds

The Mediterranean region, with its long tradition of cheese production and consumption, is the home of the dairy sheep. At the turn of the century there were more than 20 million ewes being milked, mainly in southern European countries, and this is the source of the major dairy sheep breeds of the world. Unfortunately for Australian producers, these specially developed breeds are either of very limited availability or simply unobtainable due to quarantine restrictions on imports of genetic material through live animals, semen or embryos. Some countries, e.g. in Africa and the Middle East, appear to have productive dairy breeds but due to biosecurity issues these are unlikely to be accessible. Scrapie and foot and mouth disease are well known risks.

Breeds such as the Lacaune from France, Sarda from Italy, Awassi from Israel, East Friesian from northern Europe and Chios from Greece appear to be the most productive. The Lacaune is the most advanced genetically and has the best documented performance due to production improvement schemes that have been operating for 40 years. Genetic improvement in the other breeds has had a shorter time span and not been as well organised. Production averages reported for these breeds range from 250-600 litres per ewe over lactations of up to 260 days.

East Friesian and Awassi genetics were the main imports into New Zealand and Australia in the 1990s and form a component of most of the dairy sheep flocks in both countries with the East Friesian being by far the most widespread and accessible. The Awassi imports have been contained in relatively closed flocks and access to the genetics is not readily available. Although both these breeds were originally introduced for their meat production attributes rather than for milk production, and were selected from relatively small populations, their influence on sheep dairying in Australia has been profound. Susceptibility to inclement weather has been a drawback for the East Friesian, however this has been overcome by crossbreeding with the sturdier British and local breeds.

Australian Breeds

The prime lamb and some carpet wool breeds, introduced from Great Britain since early settlement, are the most suitable for sheep dairying of breeds readily available in Australia. These include the Dorset, Border Leicester, Romney and Cheviot breeds which are the most commonly used in dairy sheep flocks, bringing superior milking ability as fat lamb mothers compared to the wool breeds but a shorter length of lactation than the imported milking breeds. There is usually some degree of East Friesian infusion in these flocks to increase production and prolong lactations.
Due more often to availability, the common wool breeds such as Merino and Corriedale are also found in dairy sheep flocks, usually as cross breds with the British or imported breeds. Other breeds used include the Texel, Dorper, Hyfer, and Coopworth.

Introduced breeds and crosses can have lactation lengths of 150-240 days and milk yields of 200-300 litres. Traditional breeds and crosses have lactation lengths of about 100-120 days and yields of 80-100 litres. Estimated production averages in Australia across all flocks are 125 litres per ewe over lactations of about 120 days.

**Flock Selection**

*Obtaining a Dairy Sheep Flock*

Numbers of sheep of more or less suitable breed are available and may be purchased through the usual outlets, ie, markets, stock agents or privately. Young ewes in good condition with a flock history including weaning rates and health status should be sought. Stock from established dairy sheep flocks are less commonly available. The possibility of buying excess ewe or ram replacements from these flocks should be investigated. The availability of semen from East Friesian, East Friesian cross, Awassi or other dairy breed rams is also worthwhile pursuing.

*Selection Criteria*

Any available information including fat lamb production should be obtained about the production achieved by a flock or individual before purchase. Annual flock production figures are a far more accurate guide than daily yields or individual herd test figures, if available. However, buyers should be aware that up to half of production is due to environmental factors. Animals will tend to produce at the level of the flock they are in and this will depend on factors such as location, feeding and management.

When considering stock, especially the purchase of rams, or ewes to breed rams from, buy only from the top performers of the flock in question. Actual production levels will tell less about the genetic value of the animal than its ranking in the flock. For example, a ewe that produces 300 litres/year in a flock where the average is 100 is a better animal than if the flock average is 200 litres/year. Some sheep flocks that do not record milk yields will have records on length of lactation of individual ewes. This is a reasonable guide to production levels.

Milk solids are not a selection criterion at present and analysis for such is not standard practice. This may change as selection for volume will have a some impact on milk solids and the producer needs to be aware of relative values. See ‘Chapter 2.4 – Flock Improvement’.
Disease status of animals purchased should be obtained. Under the National Livestock Identification Scheme (NLIS), all sheep must be tagged with approved ear tags and accompanied by a Vendor Declaration. This declaration may do as little as state that disease status is unknown but may offer protection to the buyer if the status proves different to that declared.

Parasites, drench history and possible drench resistance, mastitis, footrot and scald, caseous lymphadenitis (‘cheesy gland’) and Johnes Disease are possible problems. Ovine Johnes Disease has serious implications in some States and will lead to saleyard problems or culling of the flock. It should be noted that the intensive management of a dairy flock may bring to notice issues that were not previously a problem. Ewes are handled 1-2 times per day in close proximity to each other, so contact is closer and stress levels may also be higher. Other factors such as temperament and also the amount of wool around the tail need to be considered; see under ‘Health’.

Costs

As there are no known genetically proven stock in Australia, be wary about paying very high prices for individual rams or ewes. Generally speaking, prices are not extremely high for stock when the immediate returns are taken into account. A ewe that produces 250 litres at $1.20/litre will gross $300 in a lactation and probably more than $1,000 in a lifetime.

Settling in

Purchased stock will not perform to capacity for some time, usually until the next lactation. Younger animals probably have a better chance of settling in. This is particularly true if environmental differences are large.

There will be some inevitable culling and losses as management skills for dairying will have to be learned whether or not the farmer has previous experience with other sheep industries. Some sheep will likely be identified early as unsuitable for dairy purposes.
2.2 Mating Management

Objectives

Major aims for managing mating in a dairy sheep flock are to:
• breed sufficient ewe lambs for flock replacements/increases
• boost annual milk flow resulting from pregnancies
• concentrate lambing periods to suit flock management
• depending on market needs, to achieve ‘out of season’ milk production by spreading lambing beyond the ‘normal’ periods.
• facilitate flock improvement activities by identifying individual matings.

Depending on market requirements, a mating schedule may be planned to achieve consistent milk production from month to month throughout the year. This may mean several drops of lambs during the year, or autumn lambing.

Breeding Facts

• The natural breeding season for ewes in southern Australia is to mate in autumn and lamb in late winter - spring.
• The main trigger for cycling is reducing hours of daylight, e.g. the approach of autumn.
• In the peak breeding season, which lasts for about four months, ewes are in oestrus for about 24-36 hours every 18-25 days until they conceive. Oestrus can occur at other times of the year but is less predictable and harder to detect.
• Pregnancies last about 21 weeks.
• Lambing rate averages 1.5 per ewe, and tends to increase from 1 at the first lambing.
• Maiden hoggets can be mated at 7-8 months if well grown (30-35 kg liveweight).
• Some breeds can be lambed every 8 months and flock groups staggered to have a lambing every 1-2 months

The graph illustrates the proportion of ewes ovulating spontaneously throughout the year. There are three phases:
• a responsive phase, during which the ewe can be induced to ovulate, mate and conceive, e.g. by the ram effect.
• an active phase, when oestrus and ovulation occur spontaneously.
• and a quiescent phase, when no reproductive activity takes place.
Mating

Important procedures for best mating performance are:

- Ewes to be on a rising plane of nutrition in the month before mating
- Rams to be used at the rate of 1 per 30-40 ewes
- Introduce rams suddenly at the start of mating to achieve a rapid (7-9 days) and concentrated onset of oestrus by the ‘ram effect’.

Artificial Insemination

Artificial insemination (AI) may be considered, however this is most effectively employed for introduction of superior genetic merit to the flock. Ideally, the aim should be to use AI where semen can be obtained from rams ‘proven’ through a progeny testing scheme to carry better production genes. However, such proven semen is not yet available in Australia and there is currently no progeny testing scheme. AI has great potential for genetic improvement once this is addressed.

AI is more economical if used following hormonal treatment on groups of ewes to induce oestrus and ovulation. Conception rates with AI are lower than with natural service and AI is not recommended for maiden ewes.

Mating Practices

Identified matings are necessary in any flock improvement program where more than one ram is used. Both ewes and rams must have individual identification, ideally a tattoo backed up by ear or collar tags for ease of reading.

Holding areas for ewes are useful, and an easily accessible wall planner/calendar or notebook to record details of cycling, mating, subsequent cycling or not, pregnancy testing and expected date of lambing (see example below).

<table>
<thead>
<tr>
<th>Ewe</th>
<th>Oestrus Date</th>
<th>Service Date</th>
<th>Ram Used</th>
<th>Est. Lambing Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>121</td>
<td>1/5/07</td>
<td>2/5/01</td>
<td>Joe</td>
<td>2/10/07</td>
</tr>
<tr>
<td>123</td>
<td>21/5/07</td>
<td>22/5/01</td>
<td>Joe</td>
<td>22/10/07</td>
</tr>
</tbody>
</table>

Single ewes or groups can be put with a ram. A raddle may be used to indicate whether mating has occurred. Ewes should not have access to any other ram during that cycling period. Alternatively, group matings can occur when a ram or rams are run with ewes in the paddock. Dates of ram introduction and removal should be noted to aid management during pregnancy. Teaser rams may be used but absence of ram fertility should be confirmed beforehand.

Synchronisation

Hormone induced, ‘synchronised’ oestrus cycling in ewes can be achieved if lambing needs to be concentrated at different times of the year. Ewes to be synchronised are fitted with intravaginal sponges or Controlled Interval Drug Release (CIDR) devices containing progesterone for 18 days.

After removal of the devices, ewes will come into oestrus within 2-3 days. Synchrony of oestrus can be improved by injection of Pregnant Mare’s Serum Gonadotrophin (PMSG) when devices are removed.

For best conception rates from synchronised oestrus, the ram to ewe ratio should be increased to 1 : 5 ewes unless AI is being used for insemination.
‘Out of Season’ Mating

In southern Australia, it is possible to achieve a three month lambing interval using natural cycling, ie, matings in March and June would be expected to pose no problems without any artificial input.

However, ewes can be induced to come into reliable oestrus, ‘out of season’, by hormone administration and/or variation in lighting. The success of this technique varies with time of year and is least effective in early summer. Implantation of melatonin pellets simulates the variable lighting effect and induces oestrous cycling within a month.

Further information:

Local veterinarians, AI service providers and Departments of Agriculture.
2.3 Lamb Rearing

Systems

Lamb rearing can occur by natural (on the ewe) or artificial (hand rearing) means and there are proponents of both systems.

The usual system for natural rearing is to leave the lambs on their mothers for 4 weeks before weaning them onto pasture and solid feeds. Some producers partially extend this for another two weeks by giving lambs access to ewes for only half a day. Others start milking within two weeks from lambing but allow the ewes to nurse their lambs for various periods of the day or night. This practice, known as share milking, enables once a day milking of the ewes for that period then twice a day milking during most of the remainder of the lactation.

Advantages of natural rearing include low labour requirement and reputedly better lamb growth. However, this may come at the cost of foregone milk production which, being at its peak in the first part of the lactation, could be 50 litres or more. Sale of fat lambs from this system would appear to be a break even result at best. Some research has shown that ewes that are allowed to nurse their lambs produce as much saleable milk as ewes that are separated from their lambs at birth. These ewes can also have longer lactations, which can compensate for any lost milk during the peak.

Hand rearing is based on removing lambs from their mothers 1-3 days after birth, to ensure they get vital colostrum, and then rearing them in pens or sheds on milk replacer for a start before gradually introducing them to concentrates, hay and pasture. The major advantage of this system is that all milk produced by the ewe, apart from colostrum milk in the first day or so, can be sold or used to produce yoghurt or cheese. The downside is the cost of penning or shedding, feed and labour, and the vigilance needed to prevent disease outbreaks. Few Australian farms hand rear all lambs, the exception being ewe lambs being reared as replacements.

Ram lambs, with the exception of those selected for breeding, are usually sold or euthanased within a few days of birth.

Hygiene & Health

Hygiene and health precautions start from before birth, with the ewe’s health!

Lambing in the open is better than in a shed that has had many animals through it. If the weather is wet and cold, especially with wind chill, shelter is needed. This may be natural shelter, e.g. good tree or bush areas. If using sheds, avoid access to yards, which are always heavily contaminated. Make sure bedding is fresh and clean. Lambs at birth can pick up coccidia, worms, Johnes Disease (JD), tetanus and general infections, e.g. from staphylococci. Young animals are much more susceptible to infections than adults.

Colostrum (first milk) is essential to supply antibodies, i.e., immunity to particular diseases. Orphan lambs should be given colostrum from another ewe in the same flock.

If lambs are fed artificially their accommodation should be clean, dry and warm. Feed containers should also be clean and dry, and designed to avoid contamination from droppings or urine. Milk feeders should be washed and free from residue buildup. Dairy detergent and sanitiser can be used and feeders should be left to drain after washing. Rats, mice and birds should be excluded.
Accommodation and feeders should be thoroughly cleaned between batches of lambs to prevent build up of parasites or bacteria, inherent in all lambs. Removal of all bedding, etc., and where appropriate water pressure cleaning and disinfection, should be carried out. Leftover feed is best discarded (milk, hay and pellets) for both hygiene and palatability reasons.

Lambs should not be let out into yards. These quickly become contaminated, and coccidiosis in particular is difficult to treat once it develops. Parasites have a devastating effect on lambs. Lambs should be vaccinated against the clostridial diseases, enterotoxaemia and tetanus. The initial dose is usually given at tailing and a second dose must be given 6 weeks later. They will have some passive immunity from these via colostrum if the ewe has been vaccinated. Vaccines available are 5 in 1 or 6 in 1. Sick lambs should be removed to isolation, to prevent spread of infection and protect the sick lamb from stress.

Drenching is not usually necessary until lambs are on pasture. If parasites are suspected a ‘Worm Test’ should be done through a vet or agriculture department.

In areas with known trace element deficiencies, lambs normally receive enough through maternal supply and normal feeding until weaned. This may occasionally be inadequate. Check with your vet or agriculture department before giving potentially toxic substances.

Mulesing (if necessary) and tailing is usually done at 3-7 days along with vaccination. Mulesing is to be phased out in 2010 and tailing is likely to be phased out in the medium term. Having to deal with long tails might involve hygiene problems in the dairy, with long hairy tails getting in the way of the cups. Some sheep breeds and strains have less wool on and around the tail than others. East Friesian sheep have ‘rats’ tails’ and bare patches around the tail. Farmers need to consider the importance of selection pressure for these traits.

Feeding

Colostrum

Colostrum, as noted above, is highly nutritious and contains specific antibodies. It needs to be given soon after birth. A lamb requires 200 ml of colostrum in the first 24 hours over 3-4 feeds. Colostrum may be from the dam or another ewe, preferably not first lactation, and preferably from the same flock. Young ewes may have lower antibody levels, and another flock may not have antibodies to bacteria that are present in your flock.

Cow colostrum may be used as it appears in practice that the antibodies present are available to the lamb. Colostrum may be stored frozen - an icecube tray is ideal. If none is available, use 600ml milk, 300ml water, 2ml castor oil and one beaten egg as a substitute. This is nutritious and effective for clearing mucus and first droppings from the gut, but will not protect against disease.

Milk

It is worth considering saving colostrum or other early unsaleable milk from all ewes to raise lambs. 7 days production should equal about 7 litres, ie, more than 2 weeks feed for a lamb. If 50% of lambs are raised (the ewes), you have half their ration. NB, this practice is not suitable in some disease control programs.

Cows milk or quality milk powder/replacer is suitable for lambs. Cows milk contains about half of the milk solids of ewes milk, so more should be fed in order to compensate. The stock feed quality of powder is variable, and some are indigestible even for calves. It may be advisable to add full cream milk powder to calf milk powder to achieve fat levels of no less than 25% and protein of about 22%.
Powder should feel fine and soft, and when reconstituted should set if treated with rennet. Mix it at no less than recommended strength or levels of nutrition will be inadequate. It can be yoghurtised. This may lessen possible intolerance to ewes’ milk substitutes. Additives, such as coccidiostats and vitamin/mineral supplements may be used, and are a very good idea if coccidia have been a problem in the past.

Don’t overfeed. Lambs can safely drink about 0.5 litre/day in the first week. 1 litre/day is adequate at peak, in 1-2 feeds, as long as adequate quality solid feed is available. Some farmers feed a higher volume of milk, however less milk fed in conjunction with free access to quality supplements such as beginner calf pellets, will enable top quality lambs to be weaned earlier. Double strength mixture can be used and fed once a day, but you need to be sure some lambs are not getting too much, ie, individual feeders may be needed. Flanks should fill out nicely, not be bulging, especially when very young. Not all lambs need the same amount. Overfeeding is a major cause of death, and it also limits the early intake of solids, which is necessary for early weaning. Free access milk feeding will likewise delay weaning.

Putting a fresh feed on top of undigested milk can lead to bloat; frequent feeding can thus be dangerous. If a lamb is not keen to drink, don’t persist. It’s safer to wait till next feed. Most scour is dietary. If it occurs, give electrolyte solution instead of milk for 1-2 feeds.

Feeds can be cool, but it makes sense to feed warm milk in cold weather. Feeding very cold milk is sometimes done to limit intake, however some farmers have reported problems with this. Water should be available. If it is important that water be drunk, e.g. if double strength mixture is used, it may need to be warmed to encourage intake.

**Solid Feeds**

Calf pellets are suitable for lambs. These should be fed fresh daily, not held over from one year to the next, and not be powdery. Increase to appetite to about 220gm/lamb/day. They are convenient to feed and contain all necessary nutrients. It is quite difficult to prepare your own pellet mix with adequate calcium to replace milk.

Roughage is essential for the healthy development of the rumen needed for early weaning. Grass hay or clean oat straw is recommended; nothing too palatable or lambs will eat too much and not eat the pellets. When lambs are eating well, quality hay can be used.

Hay and pellets should be available from a few days old, no more than they will eat a day at a time. Lambs learn quickly when young and seem to have peak learning periods. If you miss these they can be very slow to get onto solids, weaning has to be postponed, and you will lose out in time, convenience and dollars.

Lambs need to be fed rations at the rate of 11 MJ/day of energy and 15-18 % protein for growth.

**Weaning**

The critical target is when they are observed to be chewing the cud. Lambs need to be eating a reasonable amount to avoid a setback, say 200g/day of pellets, plus straw or hay. Some are weaned off milk at 4 weeks and do well. A body weight of at least 12 kg is considered satisfactory for weaning.

After weaning it is prudent to leave lambs on the same solids ration for a week or so, and gradually introduce them to high quality pasture and rotational grazing, or substitutes such as silage/grain.
**Feeding Summary**

- 1 litre per lamb per day in 1 or 2 feeds, or free access; 125g powder/litre. Is this calculated at the higher strength for lambs?
- Pellets: start with a few and increase as eaten, to approx. 200g/lamb
- Hay (or straw); remove stale pellets/hay daily.
- Water available

**Equipment**

Lambs may drink direct from a container, or through a teat. They may be group or individually fed.

Feeding equipment options include:
1. A trough or buckets may be placed outside the pen so it cannot be knocked over or jumped in, feeding with heads through holes or wire or timber dividers.
2. A commercially made feeder with individual moulded sections and teats and tubes to each, can hang outside or inside pens.
3. You can easily make up a plastic ‘lambar’ bucket, about 10 L, with 8-9 holes around the top to take black lamb teats, with plastic tubing reaching to the bottom of the bucket, possibly fitted with no return valves to avoid reflux of milk back into the lambar and facilitate the learning process. Narrow tubing that fits inside the teat makes sucking easier. Use teats that flow freely.
4. Free access feeding can be used, ie, a drum with teats, once lambs have been taught to drink. Allow 6 lambs per teat. Don’t allow the milk mixture to run out, as lambs will overeat and possibly bloat when it is filled again. As lambs consume more, the mixture will need to be diluted so they do not consume too much milk and so reduce their appetite for solid feeds. A milk solids allowance of 125g/lamb/day should be maintained. For example, if lambs are each drinking an average of 2 litres day, the mixture should be offered at 125g/2 litres to the group. Alternatively, once/twice daily feeds can be substituted as appetite increases, to ensure intake of pellets.

Lambs need to be trained individually to drink. The younger they are the easier it is. One feed from a bottle is usually enough for them to learn to suck a teat, although they may need a feed or two individually on the ‘lambar’ after this. To teach lambs to drink their tails can be wagged. This generally induces them to suck on the teats and draw milk.

Pellets can be fed in hanging containers made from plastic drums with the sides cut out so that lambs can’t jump in or contaminate the feed. The drums are raised higher as lambs grow. Alternatively, troughs outside the pens can be used, with heads through as for milk.

Hay can be fed, inside or outside pens, in ‘bails’ with slats or wire to give access to lambs’ heads whilst keeping feed clean. Hay racks that need hay pulled out are a problem with excess spillage and seeds getting in eyes. Feeders outside pens, or within reach to fill from outside, are easier to manage.

Water can be provided outside pens with allowance for access, or fairly high so lambs need to stand on hind legs to drink, or stand on a narrow platform such as a bale of hay. This keeps the water clean. Automatic waterers are ideal.
**Warmth & Shelter**

Very young stock with no body fat reserves need warmth and shelter from cold, damp and draughts. The level of protection can be decreased as lambs grow and are able to tolerate more. Lamb accommodation must be clean, warm and dry at all times.

The shed should be weatherproof with good ventilation and no draughts. Construction may be simple - a three sided metal construction facing NE is fine. For maximum convenience, power and water should be available. Access for machinery for cleaning out is important, and also for feed delivery and stock trucks. A passage for access to pens and convenient, vermin-proof storage for feedstuffs are also important.

Pens may be individual or group. Individual penning minimizes transfer of infection. Small groups provide shared body warmth, but housing together too many lambs or lambs of different vigour can lead to squashing and suffocation of the smallest. Free access feeding can be managed with 50-60 together. Lambs are best grouped according to size and vigour; small, slow- drinking or weak ones in together. Movement between pens is not ideal as cross infection and aggression can occur.

A pen size of 1m x 2m for 8 lambs is adequate up until weaning. Wire walls, to allow air circulation, should be about 1m high, and rigid to avoid lambs getting caught. Welded wire of under 100cm mesh will do. A step-over (say 300cm) at the entrance will stop lambs getting out too easily when the door is opened.

A pen floor of sheep mesh is good for hygiene, but wooden slats less so. These can be over a concrete floor or well off the ground like a shearing shed. Because such raised, open floors are cold, the subfloor should be enclosed, and a bed area is needed at least initially. A few bales of hay/straw to enclose a tarpaulin holding the bedding material will do. Rice hulls or wood chips 40-50cm deep may be used.

A concrete slab with a damp-proof membrane incorporated and using rice hulls, etc, 40-50cm deep, is also a satisfactory floor. Damp bedding must be removed or topped up as moisture allows the free movement of bacteria. Rice hulls can be raked over and stay dry for months.

Any bedding material will of course need to be cleaned out and replaced between batches of lambs.

**Setbacks & Stress**

Much of the above has been to do with minimising stress. Stress leads to setbacks, resulting in less than optimal results that can have permanent effects. At the least, a stressed lamb will cost you more in time and money, maybe vet bills, later weaning, slower growth and later joining, or permanent under-development and therefore lower productive capacity. The aim is to maximise growth, economically.

Practice observing lambs, to pick up on differences in appearance and behaviour early. Problems can be dealt with sooner and simpler, hopefully before it’s too late and so that bigger problems can be avoided.

Better than that, think ahead and forestall problems. Good routine management and good habits are an excellent preventative. Be quiet and reassuring around the lambs. Stress created by poor handling is real and measurable, and benefits are quantifiable too. A lamb that wont drink may do so simply if you hold it comfortably on your lap and stroke it or wag its tail.

"Success or failure in raising calves depends to a large extent on the rearer’s attitude to the calves...’
Costs

Feed is the major cost in lamb rearing. Requirements are for energy and digestibility, as well as adequate protein, calcium, etc. These can be obtained in various ways. Cost, time and convenience are also relevant factors. Pellets may not be cheaper than powder/milk but are easier to feed, and develop capacity to eat solids, so weaning is earlier and setback at weaning less.

As a guide, approximate feed costs to about 7-8 weeks & weaning are:

- 1 x 25kg bag powder for 6 lambs @ $60 = $10.00/lamb
- 1 x 40kg bag pellets for 40 lambs @ $18 = $0.45/lamb
- 30 x bales hay/straw + bedding for 40 lambs @ $160 = $4.00/lamb

Total = $14.45/lamb

This calculation does not include labour, which highlights the importance of an efficient system. It is possible to spend as little as ½ hour/day feeding 100 lambs, once they are drinking well.

2.4 Flock Improvement

Objectives

*Flock improvement* in dairy sheep, put simply, is the deliberate and constant effort to increase animal and flock performance by selection of the best ewes and rams for milking and breeding.

The most *economically important* flock improvement objectives should be aimed for and the fewer the better. The more objectives chosen, the less will be the rate of gain in each.

Major objectives for dairy sheep should be:

+++++ Milk yield and
++++++ Lactation length (lactation length is a major factor in milk yield in sheep and has been successfully used as a selection tool on its own. These two factors are virtually the same thing as normally yield in sheep is achieved through length of lactation)
+++ Protein and fat yield (for cheese - this is not considered important at this stage of breeding but is likely to become an issue as milk volumes increase. There is a negative correlation between volume and milk solids in other dairy species)
++ Udder and teat shape
++ Clean (wool free) skin around the tail area (as discussed under ‘Lamb Rearing’)

Identification

The basis of sound flock improvement is *regular recording* and the basis of recording is *accurate animal identification*. Individual animal identification enables tracing of pedigree (for breeding and selection decisions), measurement of production (for breeding, feeding and culling) and monitoring of health (for treatment or disposal). Accurate identification and recording must start at lambing to establish pedigree connections. Immediate temporary identification (eg, by collars) is better than none.

Identification methods include:
- ear tags (metal or plastic)
- ear tattoos - most indelible
- ankle straps
- electronic chips

Identities and pedigrees should be recorded in a *permanent register* and/or on computer in readily available flock breeding programs.

*Note that it is compulsory under the NLIS to tag sheep. It would be practical to have compatible identification systems.*
Flock Recording

*Flock recording* is mainly measurement of production, and keeping records of lambing and breeding. Such records are essential for *culling, feeding and breeding decisions*.

*Production recording*, through use of milk meters is the only way of assessing each ewe’s milk yield. This can be done daily, or as little as 3-4 times per lactation. All ewes must be measured at the same milking as production comparisons between ewes can fluctuate greatly from day to day, and production comparisons should be made only on completed lactations. As mentioned earlier, recording of volume and length of lactation may be all that is needed for flock improvement at this stage. Dairy testing centres may be able provide suitably adapted milk meters on a regular basis as required.

*Milk composition* can be analysed for fat, protein, and somatic cell count (all important for cheesemaking) by sampling when production recording takes place. Samples may be sent to a test laboratory. Test laboratories may also be able to provide production reports giving yield comparisons (Production Indices) between ewes adjusted for age and time of lambing. Dairy cow testing centres may be willing to provide these services to dairy sheep. However there may be a problem in accuracy of analysis as these systems are set up for milk with much lower fat and protein. Studies would need to be done to determine the accuracy of current technical practice. It would be possible to use older technology, eg, Babcock testing of individual samples but this would be extremely time consuming.

Other milk constituents such as lactose/solids not fat/total solids are not generally of enough commercial significance to warrant monitoring.

Progress Production Report (example):

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<thead>
<tr>
<th>Ewe Details</th>
<th>Daily Production</th>
<th>Lactation to Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewe ID</td>
<td>Ewe Name</td>
<td>Age mths</td>
</tr>
<tr>
<td>124</td>
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<td>68</td>
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</tbody>
</table>

**Breeding Programs**

The ultimate use of flock records is to achieve *progressive genetic improvement* in the flock by using the best rams and ewes for breeding replacements. This is most effectively done by measuring rams’ production transmitting ability, through their progeny, and selecting the best rams to mate with best ewes to produce sons for future matings, preferably by AI. The ram has the major effect on genetic improvement because of the number of lambs sired (more than 30 times that of the ewe), thus ram selection is a critical aspect of flock improvement.

Within Flock

A breeding program within the flock is the simplest to implement but results in slower genetic improvement because of the limited sheep numbers. However, sheep flocks tend to be much larger than other farm animal populations and offer more scope for within farm selection. The first essential is to accurately record the progeny of each ram. This may necessitate ‘hand mating’, or mating individual rams separately with groups of ewes (unless AI is used). Ewes should be randomly selected to mate with each ram.
When the resulting ewes have completed their first lactation the average production of each ram’s progeny can be compared. A minimum of 5 progeny per ram is necessary for valid comparisons. The best ram should then be used as widely as possible on the flock (ideally by AI) and his sons, bred from the best ewes, used for future matings and selection of future rams.

Across Flocks
Faster and more widespread genetic improvement can be made when a number of flocks combine to ‘progeny test’ rams, based on the within flock approach. A ram can be bred to ewes in several flocks, or daughters of a ram can be distributed across several flocks. Either way, provided the minimum number of 5 ewe progeny per ram is maintained, such exchanges of rams or progeny between co-operating flocks can result in superior rams being identified for future breeding for mutual benefit. The most effective and convenient way to achieve genetic improvement across flocks is through the use of AI which permits the maximum use of superior rams and can increase the number of progeny per ram.
3. Feeding

3.1 Nutritional Needs

Daily Energy & Protein Needs

Energy and protein are the two major requirements for feeding dairy sheep, and the most important factors in calculating feed rations. Energy is the most common nutritional deficiency limiting productivity, whilst protein is a vital requirement for growth, pregnancy and milk production. Good pasture provides adequate protein for these needs except where there is a large amount of dry grass.

The following tables give minimum daily energy and protein requirements, according to ewe size, activity, age, condition and production.

Table 1  Weight Maintenance (intensive grazing on undulating land)

<table>
<thead>
<tr>
<th>Body Weight (kg)</th>
<th>Energy per day (MJ*)</th>
<th>Protein** per day (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>9.0</td>
<td>80</td>
</tr>
<tr>
<td>50</td>
<td>10.5</td>
<td>95</td>
</tr>
<tr>
<td>60</td>
<td>11.9</td>
<td>110</td>
</tr>
<tr>
<td>70</td>
<td>13.3</td>
<td>120</td>
</tr>
</tbody>
</table>

[* MJ = megajoules of metabolisable energy (ME) ** Total Protein ]

Daily requirements for housed or lot fed sheep would be about 20% less than these amounts since less energy is consumed in walking around to gather the food and dealing with weather stresses.

Additional requirements for growth, milk production and pregnancy are given in Tables 2 to 4:

Table 2  Growth (extra requirements per day)

<table>
<thead>
<tr>
<th>Growth Stage</th>
<th>Energy per day (MJ)</th>
<th>Protein per day (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to Weaning</td>
<td>6.5</td>
<td>60</td>
</tr>
<tr>
<td>Weaning to Joining</td>
<td>3.9</td>
<td>36</td>
</tr>
<tr>
<td>Joining to Lambing</td>
<td>4.1</td>
<td>38</td>
</tr>
<tr>
<td>1st to 2nd Lambing</td>
<td>0.9</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 3  Milk Production (extra requirements per litre)

<table>
<thead>
<tr>
<th>Milk fat %</th>
<th>Energy per litre (MJ)</th>
<th>Protein per litre (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>6.8</td>
<td>86</td>
</tr>
<tr>
<td>6%</td>
<td>7.0</td>
<td>97</td>
</tr>
<tr>
<td>7%</td>
<td>7.4</td>
<td>110</td>
</tr>
</tbody>
</table>

Table 4  Pregnancy (extra requirements per day)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Energy per day (MJ)</th>
<th>Protein per day (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Pregnancy</td>
<td>Zero</td>
<td>Zero</td>
</tr>
<tr>
<td>Late Pregnancy (last 2 months)</td>
<td>5.9</td>
<td>82</td>
</tr>
</tbody>
</table>

For example:
Young ewes, of 50 kg average weight, in their second lactation, in late pregnancy, producing 1 litre of milk @ 6% milk fat, and strip grazing reasonably even land, would have an average daily energy requirement, in megajoules (MJ), of:
\[
[10.5 \text{ (maintenance)} + 0.9 \text{ (growth)} + 7.0 \text{ (milk)} + 5.9 \text{ (pregnancy)}] = 27.3 \text{ MJ per day}
\]
Other Nutritional Needs

Major minerals, such as calcium, phosphorus and potassium, vitamins and some minor minerals (e.g., copper, selenium, etc.) are essential feed components, but are rarely limiting factors if grazing or green feed is provided. There may be a need for higher intake per kg/bodyweight, than other livestock. Soil or plant testing will identify any likely need for these to be supplemented.

Fibre is required in a balanced ration to control rumen acidity and aid digestion. Most bulky feeds (pastures and fodders) have a sufficient fibre component. However, rapidly growing spring pasture or a heavily grain based diet can be deficient in fibre and may result in lower concentrations of milk fat, or in extreme cases, result in acidosis.

Water is of course essential for body needs plus production. The requirement varies according to weather conditions, however the basic need for adult lactating sheep is about 2-3 litres per day, including what is available in feed, plus an allowance for milk output.

Nutrient Composition of Feeds

The following table lists the typical nutrient composition of the most common feeds. Values given are averages and the actual nutrient composition can vary slightly according to feed quality and condition. If a feed analysis is not supplied with purchased feed, or in the case of green and conserved fodders, samples of feed can be sent to a testing laboratory for analysis.
<table>
<thead>
<tr>
<th>Pastures</th>
<th>Dry Matter (DM) g/kg</th>
<th>Kg of Feed for 1kg DM</th>
<th>Energy Mj/kg DM</th>
<th>Crude Protein g/kg DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed grasses &amp; clovers</td>
<td>200</td>
<td>5.00</td>
<td>12.0</td>
<td>280</td>
</tr>
<tr>
<td>Mixed grasses &amp; clovers /flowering</td>
<td>250</td>
<td>4.00</td>
<td>10.5</td>
<td>150</td>
</tr>
<tr>
<td>Phalaris, succulent and closely grazed</td>
<td>200</td>
<td>5.00</td>
<td>9.0</td>
<td>180</td>
</tr>
<tr>
<td>Annual ryegrass. Young</td>
<td>180</td>
<td>5.56</td>
<td>11.0</td>
<td>220</td>
</tr>
<tr>
<td>Annual ryegrass. early flower</td>
<td>250</td>
<td>4.00</td>
<td>9.0</td>
<td>120</td>
</tr>
<tr>
<td>Subterranean clover, young</td>
<td>150</td>
<td>6.67</td>
<td>11.0</td>
<td>270</td>
</tr>
<tr>
<td>Subterranean clover, early flower</td>
<td>200</td>
<td>5.00</td>
<td>10.5</td>
<td>200</td>
</tr>
<tr>
<td>Lucerne in flower</td>
<td>240</td>
<td>4.17</td>
<td>10.5</td>
<td>240</td>
</tr>
<tr>
<td><strong>Green Crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>190</td>
<td>5.26</td>
<td>9.5</td>
<td>130</td>
</tr>
<tr>
<td>Oats</td>
<td>180</td>
<td>5.56</td>
<td>9.5</td>
<td>160</td>
</tr>
<tr>
<td>Wheat</td>
<td>180</td>
<td>5.56</td>
<td>9.5</td>
<td>160</td>
</tr>
<tr>
<td>Maize</td>
<td>180</td>
<td>5.56</td>
<td>9.0</td>
<td>90</td>
</tr>
<tr>
<td>Sorghum</td>
<td>200</td>
<td>5.00</td>
<td>9.0</td>
<td>110</td>
</tr>
<tr>
<td><strong>Hay</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture, mostly clover</td>
<td>840</td>
<td>1.19</td>
<td>9.0</td>
<td>140</td>
</tr>
<tr>
<td>Grass and clover, mixed</td>
<td>860</td>
<td>1.16</td>
<td>8.0</td>
<td>70</td>
</tr>
<tr>
<td>Clover, (red)</td>
<td>840</td>
<td>1.19</td>
<td>9.0</td>
<td>120</td>
</tr>
<tr>
<td>Lucerne</td>
<td>900</td>
<td>1.11</td>
<td>9.0</td>
<td>170</td>
</tr>
<tr>
<td>Oaten</td>
<td>870</td>
<td>1.15</td>
<td>7.5</td>
<td>60</td>
</tr>
<tr>
<td>Wheaten</td>
<td>870</td>
<td>1.15</td>
<td>7.0</td>
<td>40</td>
</tr>
<tr>
<td>Annual ryegrass</td>
<td>850</td>
<td>1.18</td>
<td>8.0</td>
<td>110</td>
</tr>
<tr>
<td>Phalaris</td>
<td>860</td>
<td>1.16</td>
<td>8.0</td>
<td>70</td>
</tr>
<tr>
<td>Buffel grass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>standing hay</td>
<td>900</td>
<td>1.11</td>
<td>5.0</td>
<td>80</td>
</tr>
<tr>
<td>flowering hay</td>
<td>930</td>
<td>1.08</td>
<td>8.5</td>
<td>110</td>
</tr>
<tr>
<td>Mitchel grass</td>
<td>900</td>
<td>1.11</td>
<td>7.0</td>
<td>80</td>
</tr>
<tr>
<td><strong>Straw</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>900</td>
<td>1.11</td>
<td>7.0</td>
<td>40</td>
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<tr>
<td>Oaten</td>
<td>890</td>
<td>1.12</td>
<td>7.0</td>
<td>30</td>
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<tr>
<td>Wheaten</td>
<td>890</td>
<td>1.12</td>
<td>5.5</td>
<td>50</td>
</tr>
<tr>
<td><strong>Silage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture (mostly clover)</td>
<td>220</td>
<td>4.55</td>
<td>8.5</td>
<td>210</td>
</tr>
<tr>
<td>Mixed grass and clover</td>
<td>200</td>
<td>5.00</td>
<td>8.0</td>
<td>120</td>
</tr>
<tr>
<td>Maize</td>
<td>250</td>
<td>4.00</td>
<td>9.0</td>
<td>80</td>
</tr>
<tr>
<td>Oats</td>
<td>290</td>
<td>3.45</td>
<td>8.0</td>
<td>90</td>
</tr>
<tr>
<td>Wheat</td>
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</tr>
<tr>
<td>Barley</td>
<td>250</td>
<td>4.00</td>
<td>9.0</td>
<td>180</td>
</tr>
<tr>
<td>Seeds &amp; Grains</td>
<td>Dry Matter (DM) g/kg</td>
<td>Kg of Feed for 1kg DM</td>
<td>Energy Mj/kg DM</td>
<td>Crude Protein g/kg DM</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------</td>
<td>-----------------------</td>
<td>-----------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Barley</td>
<td>870</td>
<td>1.15</td>
<td>12.0</td>
<td>110</td>
</tr>
<tr>
<td>Linseed</td>
<td>920</td>
<td>1.09</td>
<td>12.5</td>
<td>200</td>
</tr>
<tr>
<td>Lupin (narrow leafed)</td>
<td>890</td>
<td>1.12</td>
<td>13.0</td>
<td>310</td>
</tr>
<tr>
<td>Maize</td>
<td>880</td>
<td>1.14</td>
<td>12.5</td>
<td>110</td>
</tr>
<tr>
<td>Millet (Japanese)</td>
<td>890</td>
<td>1.12</td>
<td>11.5</td>
<td>140</td>
</tr>
<tr>
<td>Oats</td>
<td>890</td>
<td>1.12</td>
<td>12.0</td>
<td>110</td>
</tr>
<tr>
<td>Peas</td>
<td>860</td>
<td>1.16</td>
<td>13.0</td>
<td>250</td>
</tr>
<tr>
<td>Sorghum</td>
<td>870</td>
<td>1.15</td>
<td>12.5</td>
<td>130</td>
</tr>
<tr>
<td>Soybean</td>
<td>900</td>
<td>1.11</td>
<td>13.5</td>
<td>500</td>
</tr>
<tr>
<td>Sunflower</td>
<td>930</td>
<td>1.08</td>
<td>10.5</td>
<td>330</td>
</tr>
<tr>
<td>Vetch</td>
<td>870</td>
<td>1.15</td>
<td>13.5</td>
<td>300</td>
</tr>
<tr>
<td>Wheat</td>
<td>890</td>
<td>1.12</td>
<td>13.0</td>
<td>140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Protein rich Meals</th>
<th>Dry Matter (DM) g/kg</th>
<th>Kg of Feed for 1kg DM</th>
<th>Energy Mj/kg DM</th>
<th>Crude Protein g/kg DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut meal</td>
<td>890</td>
<td>1.12</td>
<td>13.0</td>
<td>230</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>900</td>
<td>1.11</td>
<td>12.0</td>
<td>430</td>
</tr>
<tr>
<td>Linseed meal</td>
<td>890</td>
<td>1.12</td>
<td>13.0</td>
<td>340</td>
</tr>
<tr>
<td>Linseed meal, extracted</td>
<td>890</td>
<td>1.12</td>
<td>11.5</td>
<td>350</td>
</tr>
<tr>
<td>Peanut meal</td>
<td>930</td>
<td>1.08</td>
<td>13.5</td>
<td>520</td>
</tr>
<tr>
<td>Rapeseed meal</td>
<td>920</td>
<td>1.09</td>
<td>10.5</td>
<td>380</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>860</td>
<td>1.16</td>
<td>13.5</td>
<td>500</td>
</tr>
<tr>
<td>Soybean meal, extract</td>
<td>890</td>
<td>1.12</td>
<td>12.5</td>
<td>500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cereal and other by-products</th>
<th>Dry Matter (DM) g/kg</th>
<th>Kg of Feed for 1kg DM</th>
<th>Energy Mj/kg DM</th>
<th>Crude Protein g/kg DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oat bran</td>
<td>900</td>
<td>1.11</td>
<td>9.5</td>
<td>90</td>
</tr>
<tr>
<td>Rice bran</td>
<td>900</td>
<td>1.11</td>
<td>8.0</td>
<td>60</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>860</td>
<td>1.16</td>
<td>10.0</td>
<td>150</td>
</tr>
<tr>
<td>Sugar cane molasses</td>
<td>760</td>
<td>1.32</td>
<td>12.5</td>
<td>130</td>
</tr>
</tbody>
</table>

*Note: High grain intake may lead to acidosis*

**Energy & Protein Costs in Feeds**

The table below gives a guide to the typical digestible energy and crude protein costs of several feeds, based on nominal prices.

**Table 6 Energy & Protein Costs in Feeds**

<table>
<thead>
<tr>
<th></th>
<th>Price/kg</th>
<th>Digestible Energy</th>
<th>Crude Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MJ/kg</td>
<td>Cost/MJ</td>
</tr>
<tr>
<td>Lucerne Hay</td>
<td>44 cents</td>
<td>9.6</td>
<td>3.1</td>
</tr>
<tr>
<td>Pasture Hay</td>
<td>28</td>
<td>9.0</td>
<td>100</td>
</tr>
<tr>
<td>Triticale</td>
<td>16</td>
<td>12.5</td>
<td>108</td>
</tr>
<tr>
<td>Oats</td>
<td>32</td>
<td>10.5</td>
<td>96</td>
</tr>
<tr>
<td>Soya Bean Meal</td>
<td>87</td>
<td>13.1</td>
<td>445</td>
</tr>
<tr>
<td>Linseed Meal</td>
<td>70</td>
<td>12.3</td>
<td>346</td>
</tr>
<tr>
<td>Pasture (Dry)</td>
<td>4</td>
<td>10.0</td>
<td>200</td>
</tr>
</tbody>
</table>
3.2 Grazing Management

Objective

The prime objective for grazing dairy sheep is to maximise the quantity of fresh pasture in the diet all through the year. This achieves the aim of minimum cost feeding with feed of maximum nutritive value. Feed additives are not required to supplement fresh pasture which contains the ideal natural blend of energy, protein and minerals.

Supplementary feeding of hay, silage, grain, etc., to meet feed requirements is often needed in south eastern Australia when pasture is in short supply (winter and summer) however well grown pasture, rationed through the year by a rotational grazing system, can minimise the need for expensive substitutes.

Pasture Production

Maximising pasture feed supply is achieved through a combination of:
- vigorous pasture grass and clover species
- use of the correct fertiliser types and quantities.

This can usually be done without ploughing and resowing paddocks as most grazing land has a proportion of the better species already present. Correct fertilising is often sufficient to promote the growth of these species. Oversowing can also be used to add desired species. Proper fertilising will also lead to better root systems, longer persistence of quality pasture, and healthier soil biology, e.g. worms and higher organic matter.

Advice on the best pasture species and fertiliser needs for particular districts is obtainable from local agricultural department offices, farm advisers and fertiliser company representatives. Soil sampling is recommended to determine plant nutrient deficiencies and fertiliser needs.

Grazing Management

Best use of pasture feed is achieved by a combination of:
- budgeting feed supplies and requirements for all sheep through the year, and
- rotationally or strip grazing pasture areas to maximise supply for the milking flock.

These strategies allow planning for the best use of available feed and land, and forecasting supplementary feed needs.

Feed Budgeting

Energy and protein requirements for maintenance, growth and milk production for the different classes and ages of the sheep flock should be plotted through the year using the tables in the chapter on Nutritional Needs and compared against monthly feed supply from pasture, and other sources as needed. The emphasis should be on the needs of milking ewes as this will comprise the major proportion of the total flock feed budget.

Protein is rarely a limiting nutrient factor where pastures are grazed, except when there is a large amount of dry grass. Energy is the most common nutritional deficiency limiting productivity. Energy deficiencies can occur when feed availability is low, when pastures are dry or contain very high moisture levels, and at peak lactation with highly productive breeds as the animals will simply not have the ruminal capacity to ingest the required amount of energy from pasture alone. Decisions about supplementary feeding in these situations need to be based on costs and returns. Feed budgeting based on grazing can be simplified by concentrating on energy supplies and requirements.
An example of a simple Feed Budget, based on Energy needs, for a strip grazed flock increasing from 400 to 500 ewes, average weight 50 kg, producing 1.0 litre @ 6% fat, on 40 hectares, from late winter through early spring, is:

<table>
<thead>
<tr>
<th>Pasture Feed Supply</th>
<th>August</th>
<th>September</th>
<th>October</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg of Pasture Dry Matter grown</td>
<td>12,000</td>
<td>24,000</td>
<td>36,000</td>
</tr>
<tr>
<td>Megajoules (MJ) at 12 per Kg</td>
<td>144,000</td>
<td>288,000</td>
<td>432,000</td>
</tr>
<tr>
<td>Energy Needs (MJ)</td>
<td>Maintenance &amp; Activity</td>
<td>130,200</td>
<td>141,750</td>
</tr>
<tr>
<td>Milk Production</td>
<td>86,800</td>
<td>94,500</td>
<td>108,500</td>
</tr>
<tr>
<td>Total MJ needed</td>
<td>217,000</td>
<td>236,250</td>
<td>271,250</td>
</tr>
<tr>
<td>Surplus/Deficit of Energy</td>
<td>- 73,000</td>
<td>-51,750</td>
<td>+ 160,750</td>
</tr>
</tbody>
</table>

Energy deficits can be made up from pasture saved prior to the budget month, and/or supplementary feeds. Energy surpluses can be carried forward to future months, or in the case of spring growth, cut for silage or hay. Early spring pasture may also need supplementation with fibre rich feeds to aid digestibility. Advice on Feed Budgeting is available from most independent or government dairy advisors.

**Rotational Grazing**

Providing rationed, pre-determined quantities of pasture feed, according to flock requirements is achieved by matching the feed budgets with pasture quantities, supplied in strips (strip grazing with electric fence) or small paddocks (grazed in varying rotation lengths according to season and pasture growth rates). As a guide, strips or areas giving a stocking rate equivalent of 2,000 ewes per hectare per grazing period, e.g. 500 ewes on 0.25 hectare per day, are typically used.

These systems have the twin advantages of providing fresh, nutritious pasture at each grazing, maintaining even pasture quality by preventing over or under grazing, and avoiding grazing of very short pasture to minimise worm larva intake.

**Feed Available from Pasture**

For dairy sheep to get enough energy from pasture, the feed must be above a certain quality and there has to be enough of it. Pasture availability is measured as kilograms of dry matter per hectare and can be estimated by measuring the height of the pasture, as shown in the following table:

<table>
<thead>
<tr>
<th>Average Pasture Height (cm)</th>
<th>Pasture Dry Matter (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>2</td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>1100</td>
</tr>
<tr>
<td>4</td>
<td>1400</td>
</tr>
<tr>
<td>5</td>
<td>1700</td>
</tr>
<tr>
<td>6</td>
<td>2000</td>
</tr>
<tr>
<td>7</td>
<td>2300</td>
</tr>
<tr>
<td>8</td>
<td>2600</td>
</tr>
</tbody>
</table>

Pasture height can be measured by special meters developed for the purpose, or by simple measuring sticks. Both techniques require some practice, but once mastered, visual assessments of pasture height can often be confidently made as an alternative from time to time. Advice and tuition concerning these techniques are available from agricultural advisors and research institutes.
Pasture Height Targets

The aim of rotational grazing is to access pasture when it is a suitable height, before it becomes rank or too many grass leaves die off, and quickly graze the pasture down to a height from which regrowth will be fast. The following table gives several ideal ‘before and after’ pasture height targets:

<table>
<thead>
<tr>
<th>Ewe Condition</th>
<th>Pasture Range (kg DM/ha*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry ewes at mating</td>
<td>2500 - 1800</td>
</tr>
<tr>
<td>Late pregnancy</td>
<td>2400 - 1300</td>
</tr>
<tr>
<td>Milking ewes – high quality pasture</td>
<td>2500 - 1800</td>
</tr>
<tr>
<td>Milking ewes – mod. quality pasture</td>
<td>2500 - 2000</td>
</tr>
</tbody>
</table>

* the last figure is the level to which the pasture should be grazed.

Note: Dairy ewes have an upper pasture intake limit, based on good quality, highly digestible herbage of about 3.6% of liveweight, ie, 1.8 kgDM/ewe/day for a 50 kg ewe or 2.2 kgDM/ewe/day for a 60 kg ewe. It is apparent that ewes producing close to 3 litres per day could have difficulty maintaining weight under pasture feeding alone. Because of this, concentrate feeding is a major component of the diet for high yielding dairy ewes.

3.3 Weight & Condition Score Targets

Weight Targets

Generally accepted weight, growth rate and age targets are similar worldwide. However, mature ewes can range from 40-90kg (average 60kg).

<table>
<thead>
<tr>
<th>Life Stage</th>
<th>Weight Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>3-5g</td>
</tr>
<tr>
<td>Weaning (off milk)</td>
<td>12kg (4-5 weeks)</td>
</tr>
<tr>
<td>Mating</td>
<td>30-35 kg (7 months)</td>
</tr>
<tr>
<td>Lambing</td>
<td>50-55 kg (12-15 months)</td>
</tr>
<tr>
<td>Mature ewes</td>
<td>average 60kg</td>
</tr>
<tr>
<td>Mature rams</td>
<td>80-100 kg</td>
</tr>
</tbody>
</table>

Ewes should gain 10-20 kg during the last six weeks of pregnancy, most of that weight gain being in the placenta and foetus, and lose only 5% of true liveweight in the six weeks following lambing. Losses greater than 10% result in decreased milk yields.

Condition Score Targets

Condition scores are based very closely on the system for dairy cows and indicate how fat is the animal. There is no real relationship between the weight of an animal and the condition score as weight includes the sum total of bone, muscle, fat and other body constituents.

Once an animal has reached maturity it is the condition of that animal, ie, the amount of muscle and fat which determines how well she will produce. Ewes will use body fat to meet energy requirements to produce milk soon after lambing. This is a time when she cannot physically eat enough to meet milk production requirements so she will mobilise body fat and lose condition to do it. Therefore if the ewe is in poor condition at lambing she will not be capable of producing large quantities of milk as she cannot get the energy from pasture or from her own reserves.
Condition scoring assesses the amount of body fat or condition by feeling the vertical and horizontal processes of the spine along the loin area.

Condition scores 0-2 indicate underfeeding and low production. Scores of 3-4 indicate good feeding and high production. A score of 5 indicates over feeding and over fatness. Ewes should be mated in condition score 4 and lamb at a condition score of 3.5-4. An averaged size ewe will need to gain approximately 5 kg in order to increase one condition score.
Acknowledgement: Department of Agriculture Western Australia
4. Health

Milk production is acutely sensitive to stress factors. Even minor issues may have a noticeable impact from day to day and chronic disease in the flock is likely to make the enterprise unviable.

Some common problems are:

4.1 Fly Strike & Soiled Wool

Fly Strike

Flystrike is worst in warm moist conditions. Blowflies lay their eggs in moist wool and the maggots burrow into the skin causing severe inflammation. Infection develops locally and blood poisoning may follow. The smell attracts more blowflies and the condition worsens. Production losses are high, with loss of milk, body weight, wool and death. Fleece rot, footrot, urine and faecal stains on the wool, and any injury to the sheep, all attract blowflies and are risk factors.

Management

Treatment of any problems will need to take account of residue issues, both systemic as in drenches, and local applications. Most products have no information on withholding periods for milk producing animals. The area affected should be shorn, and maggots removed. Sunscreen may be needed if the area is raw. Shade should be provided if possible. Antibiotics may be needed if the site is infected, and withholding periods must be observed. If a ewe is severely struck she should be treated with an appropriate chemical and removed from the milking flock. An organic dairy sheep farmer has found that wood fire ash will kill the maggots after the sheep is shorn.

Flies in the milking area can be dealt with by approved surface sprays (check with your local Department/QA body). Fans are commonly used in milking premises as flies dislike disturbed air. Regular crutching is probably the most desirable management tool. Some operators shear twice yearly. The cost is covered by returns from wool.

Soiled wool

Mulesing will be phased out by 2010, and tailing is likely to be phased out in the mid term. This will make it necessary to deal with any animal health issues that may arise from soiled wool, eg, flystrike. Also, having to deal with long tails might involve hygiene problems in the dairy, with long daggy tails getting in the way of the cups.

Genetics

Some sheep breeds and strains have less wool on and around the tail than others. East Friesian sheep have ‘rats’ tails’ and bare patches around the tail. Farmers need to consider the importance of selection pressure for these traits.

Management

These new restrictions are a challenge for all sheep farmers. Dairy sheep management would appear to be easier due to ewes being bailed regularly and thus able to be monitored with relative ease.
4.2 Lice

There are three species of lice that infest sheep, two are sucking and one a body or biting louse. The biting louse can cause great distress to the ewe and may reduce milk production in severe cases. Infested sheep scratch and rub the itchy parts of their bodies against fences, trees, walls and anything else they can find and while they are doing this they are spending less time eating. They also tend to bite themselves, pulling wool out. Fleece quality can be reduced by the rubbing. Blood sucking lice are much less common.

Lightly infested sheep may show no clinical signs but as numbers increase the rubbing and scratching increases. Once a few ewes have infestations the lice spread rapidly throughout the flock. The conditions whereby ewes are brought into close contact twice a day for milking is ideal for lice transmission.

Lice tend to live in long wool more, and shearing reduces the population. Dipping is not recommended until the ewes are non lactating and dipping should not take place immediately before lambing as the residuals of the dip could get into the milk. Consult your veterinarian or the manufacturer of the dip to enquire about milk withholding period. Check any new sheep entering the property and treat for lice if necessary.

All ewes on the property should be treated at the same time to eradicate lice or reinfection will occur. Sheep lice do not live long away from sheep.

Residues from dips and back-line preparations for lice control are a major concern to the sheep milking industry and withholding periods should be strictly followed.

Withholding periods may be up to 60 days depending on chemical used.

4.3 Foot Problems

Foot problems, especially in higher rainfall areas, can cause significant loss of production.

Genetics

Choose stock, especially rams, with sound feet. The outer hoof should be hard without being brittle, the inner firm and resilient. There should be no space between inner and outer layers. Some sheep have naturally compact hooves which resist mud packs collecting. Some grow straight and will break off at a good angle. Other animals will rock back on their feet and long curls develop at the toe.

Environment

The environment should be as mud free as possible. Mud packing in between the outer layer of the hoof and the soft inner hoof is a problem. This can cause lameness from pressure alone, and also predisposes to infections. Untreated hoof infections can progress to bone infection and loss of the animal.

Laneways are a major culprit. Make sure they are well formed and drained, with an impervious surface. An added benefit will be mud free udders and better quality milk. Information on farm track design and construction is available from agricultural advisers in dairy or quality monitoring bodies. Moveable water troughs can help minimise pugging (excessive mud formation) at drinking points. Alternative gateways may be possible with electric fencing.
Disease

Diseases such as foot abscess, scald or footrot (which is caused by a specific bacterium, and a notifiable disease in most States) should be avoided and treated effectively with veterinary assistance if present. The three are not always separate and one can sometimes lead to another. Persistent or recurrent lameness will have a severe impact on milk production.

Management

Adequate nutrition and general health of animals is most important. Stress periods will be visibly reflected in later hoof growth. In some areas and circumstances, micronutrients such as zinc may be indicated.

Foot baths are commonly used for prevention and treatment of problems especially in wetter areas, usually at milking shed exit races. If foot baths are used, feet should be monitored to ensure that they do not dry out too much and crack. Mats soaked in formula may be used instead of liquid baths, and are reported to be more acceptable to sheep (less avoidance and slowing of stock flow) and present less risk of splashing, which may in turn result in contamination of the milk with the footbath chemical. Zinc, copper sulphate or formalin are commonly used in footbaths. Follow the instructions on the label. Footbath chemicals should be treated with care as they can cause tissue damage to stock and operators.

Hoof trimming is not usual. If it is felt to be needed, all foreign material should be cleaned out and the outer hoof wall may need to be trimmed back to prevent immediate mud packing recurring. Avoid cutting to the point of bleeding.

Protective boots are available from some stock supply outlets, and some farmers make their own from inner tubing. Zinc or other applications may be mixed with petroleum jelly inside the boot. Equipment used has included carpenter’s surform, hand operated footrot shears, angle grinders and pneumatic hoof trimmers.

Common Foot Problems

- Puncture type injury from a sharp object; commonly sole of foot or junction of toes.
- ‘Strawberry’ bruise in the soft hoof tissue. Foot scald causes irritation in the skin between the two toes of the hoof. The skin becomes raw and moist.
- Foot abscess, which can follow on from either of the above. Foot abscesses cause severe lameness in dairy sheep. Wet conditions cause feet to soften and become more susceptible to damage, for example from rough laneways. Dirty conditions in the holding yards and milking shed, and the very regular exposure to these, can spread foot abscess readily through the flock.
- Footrot is caused by a specific organism, *Fusiformis necrophorus*, and is a notifiable disease.
- Laminitis or founder may occur as a result of heavy grain supplementation. The hoof becomes swollen and hot. Permanent damage and lameness often results.
- Fracture of a bone above the toes.
4.4 Johnes Disease

Johnes Disease (JD), or paratuberculosis, is present in many ruminant species. It is an insidious disease, which causes considerable loss of stock and production. It is present in many dairy cow and goat herds and sheep flocks in Australia. In some states (eg, WA) it is a notifiable disease that may involve the destruction of all stock and strict quarantine imposed on the affected farm. The ovine form affects sheep, the bovine form affects cattle and goats. Goats have been shown to be susceptible to ovine JD under some conditions.

The bacterium mostly affects the gut, and less commonly the reproductive tract and udder. Infected animals that are not showing symptoms will intermittently pass the bacteria in their droppings, thus spreading the disease widely. It can survive in the soil for years under moist conditions. It is usually caught by young stock from the dam or from infected surroundings. It is not known whether older sheep remain susceptible to infection.

The infected animal typically shows no sign of disease for years, and then starts to lose weight rapidly in spite of a good appetite, scours, and dies.

Management

Consult with your local Department of Agriculture and veterinarian regarding disease and control measures. Diagnosis should be confirmed before action is taken. There are schemes to accredit flocks, or supply various levels of market assurance. Check with your State Department of Agriculture.

On a flock basis, several pathology tests are useful, but individual diagnosis is more difficult. Animals that are infected but not showing signs of disease are particularly difficult to diagnose. Faecal cultures are used but do not always show disease when it is present, and take 6-8 weeks. Post mortem examination of the ileo-caecal node is recommended.

There is no practicable treatment for infected livestock. Vaccination is recommended and is subsidised in some States. Check with your local Department.

Lambs from known or suspected infected dams should not be kept as transmission can occur in utero.

Animals in poor condition, or from a flock in poor condition or with a known history of Johnes Disease, should not be purchased. When buying stock, the purchaser should enquire about flock health and obtain a Vendor Declaration. This Declaration may indicate as little as ‘unknown health status’, or may be quite specific with regard to disease/s. It can clarify health issues and offers legal protection to the purchaser.

Acknowledgements:
Victorian Institute of Animal Science, Attwood

4.5 Hypocalcaemia (milk fever)

Milk fever can occur before or after lambing and is more common in older ewes. As milk production increases it is possible the incidence will increase at or shortly after lambing; this has been observed in some high producing strains. Losses may occur due to death of ewe and/or lamb, and loss of milk production.

Milk fever is caused by low calcium levels in the blood. The extra demands of the foetus or of milk production become too much for the ewe to meet. She cannot absorb enough calcium from her diet, nor can she mobilize enough from her own body reserves. Associated low magnesium and phosphorus blood levels inhibit the utilisation of calcium reserves.
Risk factors include lush rapidly growing spring pasture, starvation, and sudden feed checks, as may occur in yarding before lambing.

The ewe may be agitated and over active for a brief period, then have hindquarter weakness and go down with associated loss of appetite. The animal sits with its head turned to the flank. Bloat is likely to occur quickly as rumen gases cannot escape. Usually at least several animals are affected. If untreated, death usually follows within 24 hours.

**Management**

Avoid any stress in late pregnancy or early lactation. This includes extensive yarding and handling, such as shearing, and sudden changes in feeding.

Adequate phosphorus in the diet prior to calving is recommended for dairy cows and may be effective in other ruminants.

Treatment is calcium borogluconate given under the skin as per the manufacturer’s instructions. The ewe will recover remarkably quickly, within 30 minutes. If she does not respond, pregnancy toxaemia may be developing and she should be treated for this.

### 4.6 Pregnancy Toxaemia (sleepy sickness)

Pregnancy toxaemia typically occurs in late pregnancy with multiple fetuses. Lambs are often born dead, and ewe losses will occur if the condition is not treated promptly. Once a ewe is down she is likely to die.

It is caused by glucose deficiency, when the demands of the pregnancy are higher than what is available in the diet. It can be precipitated by a variety of stress situations such as a period of feed shortage (yarding, shearing of heavily pregnant ewes) or ongoing restriction of diet when the ewe’s nutritional needs are growing. Older ewes, overweight ewes, loss of appetite due to any cause including insufficient room for feed due to the pregnancy, too much competition for feed, insufficient shelter, lack of exercise, are all contributing factors.

In the early stages ewes are depressed, not willing to eat and don’t want to move. Later the head may appear in an unnatural position and she may seem to be blind. White froth appears around her mouth and she will grind her teeth.

**Management**

Avoid known precipitating factors as above. Provide a rising plane of nutrition over the last 6 weeks of the pregnancy.

Treatment must occur early. Glycerol or propylene glycol is given, 60-120 ml per day. Glucose is not suitable due to ruminant metabolism. Treatment for milk fever should also be given if there is any doubt as to whether the problem is pregnancy toxaemia or milk fever. A caesarian section may be performed for valuable ewes; removal of the lamb should reverse the problem.
4.7 Hypomagnesia (grass tetany, grass staggers)

This is due to magnesium deficiency and is caused by either lack of magnesium in the pasture, or some inability to absorb magnesium, or a combination of these. It is usually preceded by a drop in feed intake or a period of bad weather which leads to an energy balance disturbance. The animal is lethargic and loses appetite, and if disturbed she develops muscle tremors and staggers when she tries to move. Ewes are often found dead.

Management

Prevention: drench ewes with magnesium oxide 3 weeks before lambing and during early lactation. Paddocks may be dusted with magnesium.

High potassium and ammonium in pasture can decrease the absorption of magnesium. Potassium fertilizer applied in late spring will reduce high potassium pasture at times when magnesium demand is highest.

Treatment is by 50-100 ml of magnesium sulphate 10% and calcium borogluconate 25% given under the skin.

4.8 Clostridial diseases

These include pulpy kidney, tetanus, black leg black disease and malignant oedema.

Prevention is in the form of an annual vaccination program which is usually given to pregnant ewes 2-6 weeks before lambing. Lambs are then vaccinated as soon as possible after weaning, or at tailing, and a booster is given 4-6 weeks later. Ewes are given a further booster at 18 months of age, with the older ewes 2-6 weeks before lambing and thereafter annually. There are several combinations of vaccines used: 5-1, 6-1 or 7-1, depending on which clostridial diseases are known on the property.

4.9 Mastitis Control & SCC

The most common pathology of the mammary gland in sheep dairies is mastitis, an inflammation of the udder caused by infection of the mammary tissue. Mastitis is economically important for sheep dairies because it reduces milk production and causes qualitative changes in milk composition, which alter the processing performance of the milk and the qualitative characteristics of the dairy products obtained.

Somatic cells increase dramatically with any inflammatory or pathological process affecting the mammary gland. A high somatic cell count results in changes in the composition of milk. These changes are accompanied by a worsening of the clotting parameters such as renneting time, rate of curd formation and curd consistency and a reduced cheese yield due to an increased loss of fat in the whey. High somatic cell counts in milk have been associated with problems in the quality of cheese.

Clinical mastitis occurs when the animal has signs of infection; the udder can be hot, red, uneven or with lumps. The milk could also have lumps, or look watery or have blood in it. Ewes rarely have stringy milk, and are much more likely than cows to develop lumps, abscesses and fibrosis in the udder. Initial inflammation may be missed by the farmer.

Subclinical mastitis has no outward signs. Subclinical cases of infection may be detected when Somatic Cell Counts (SCC) are done. We cannot be confident as to what level of SCC is significant in ewes (see below). However, ewes with a SCC of around 1,000,000, or an increase in the number of high SCC ewes, should be investigated further. Discuss this with your vet.
**Mastitis detection** can be by the rapid mastitis test or with an electronic mastitis detector. The first is based on mixing a soapy solution (1/3 dishwashing detergent and 2/3 water) with a few squirts of milk. The mixture becomes viscous and looks like mucus if positive for mastitis. This method is not very sensitive and may miss infections. Electronic mastitis detectors are based on the fact that the conductivity of milk changes dramatically if mastitis is present. Although not readily available in Australia, these detectors can be ordered online from the USA for a reasonable price. These detectors are suitable for use in sheep milk as shown by researchers in Italy.

**Somatic Cell Counts**

Cell counts are used as a method to determine levels of mastitis infection in individual ewes, or in bulk milk samples taken from a vat. They may be taken at regular intervals by dairy companies, or by herd improvement centres when individual ewes are tested.

With dairy cows, an individual SCC over 250,000 indicates infection (Countdown Downunder 2000). Ideally this should be measured between 30 and 250 days of lactation. A BMCC (Bulk Milk Cell Count) above 200,000 indicates that either clinical or subclinical mastitis is present to a significant degree within the herd. In general sheep milk has higher SCCs than cows milk. Also, goats milk has been considered to ‘naturally’ have a higher count than cows milk but this may not be the case.

French requirements for goats milk are for a BMCC of less than 1,000,000 with a target of 300-400,000 being considered. A clear relationship is claimed between SCC, milk production and milk quality, with counts over 1,000,000 giving a 17% reduction in cheese yields. A French study has shown that if the SCC rolling average is less than 500,000, 72% of goats are considered healthy, and if it exceeds 2,000,000 more than ½ the herd is probably infected, and more than 15% of these with major pathogens. SCCs are declining in France since they have been a milk payment factor.

Fosssomatic results are considered to be reasonably accurate.

**Do not confuse SCC and Plate Count results**

A plate count is an indication of bacterial levels in the milk. The SCC is an indication of the number of cells (most of which are white blood cells) being shed in the milk. White blood cells are part of the animal’s mechanism to repair tissue and fight infections, including mastitis.

When milk is extracted from healthy mammary glands, the milk is practically sterile. Therefore, the microbial count of milk depends on the hygienic conditions in the milking parlour and on the method of storage and transport of the milk, as well as the health of the ewe.

**What if the cell count is rising?**

Immediate steps should be taken if the cell count is increasing:

1. Inspect udders for teat damage (a sign of machine malfunction).
2. Have your milking machine technician check the rubberware, pulse operation, vacuum levels and efficiency of the regulator.
3. Investigate machine operation during milking, i.e. check for milk line flooding, cup slip and other telltale signs of poor milking performance.
4. Check the milking machine for capacity, in relation to liquid flow rates, and individual sheep production.

Seek veterinary advice to identify the type of infection.
**Mastitis Prevention**

Some steps which can be undertaken to prevent mastitis include:
1. Minimise further spread of mastitis in the herd by correct identification and treatment of clinical and subclinical mastitis.
2. Use a teat spray (or dip) after milking each sheep. Ensure each teat is treated throughout lactation. Emollient in the spray according to instructions will assist maintaining healthy teats.
3. Have your milking machine tested regularly by a qualified milking machine technician.
4. Cull ewes with persistent cases of mastitis.
5. Use an effective dry cow treatment (discuss program with your veterinarian). Note that in goats a popular dry cow treatment, benzathine salt of cloxacillin, has been demonstrated to sometimes remain in udders for an extended period after kidding, when used in line with recommendations for use in cattle.
6. Consult your vet with regard to end of lactation treatments.

**Mastitis Treatment**

Steps used to treat mastitis include:
1. Identify ewes with clinical mastitis, and treat in consultation with your vet. Clinical mastitis may be treated during lactation. Subclinical cases of mastitis should be monitored, and treated at drying off.
2. Have bacteria identified by sterile culture. This can show whether the cause is of environmental or animal origin, and indicate useful preventative measures. It will also indicate the most suitable antibiotic treatment.
3. Cull ewes with persistent cases of mastitis.
4. Teat spray all sheep in the herd.

_The strongest weapon for the long term reduction of mastitis levels in your flock is the correct use of available control measures in conjunction with veterinary advice. Hygiene requirements and the basics of infection spread and control are the same regardless of species._

**Mastitis Control Program - “3x3x3”**

A. Prevent New Infections

**Milking Machines**

- Check and service annually
- Avoid slipping teat cups
- Ensure effective pulsation

**Milking Management**

- Keep udders clean; maintain lanes and gateways in good repair; clip udders and crutch as necessary.
- Put cups on clean dry teats.
- Remove teatcups gently and only after switching off the vacuum.

**Post Milking Hygiene**

- Use freshly prepared teat disinfectant at recommended strength all year round.
- Ensure the glycerine emollient concentration is not above 10%.
- Ensure complete coverage of all teats.

B. Remove Existing Infections
Treatment of Clinical Cases

- Consult your vet with regard to treatment.
- Use the recommended antibiotic in the recommended manner, and use the full course of treatment.
- Clearly mark treated ewes and withhold the milk for the recommended period.

Treatment at Drying Off

- Consult with your vet. Treat or cull all ewes that have persistently high SCCs or have a history of mastitis problems. If individual details are not available, consult your vet who may recommend to blanket treat the whole flock. Note: benzathine salt of cloxacillin, has been demonstrated to sometimes remain in goat udders for an extended period after kidding, when used in line with recommendations for cattle use. It is possible that this may also occur in sheep.
- Clean and sanitise teats before and after treatment.
- Do not use one tube/syringe in more than one teat.

C. Monitor Progress

Monitor the Bulk Milk Cell Count

- Counts below 300,000 are achievable in cows and goats
- Counts below 400,000 are desirable.
- Plot the rolling 6 month average as a guide to performance.

Identify Subclinical Cases

- SCCs above 1,000,000 should be further investigated.
- Plate counts are probably the best way to confirm infection.
- Treat subclinical cases during lactation only under veterinary advice.

Records

- Record each udder half treated or suspected for all ewes.
- Monitor the rate of clinical cases detected.
- Check antibiotic sensitivity pattern of the bacteria involved.


4.10 Worm Control

Objective

The sole objective in parasite management in dairy sheep is to minimise the effects of parasitical worm burdens, thereby achieving improved productivity and general health and vigour. Problem worms can never be eliminated from a flock but can be controlled to an acceptable degree.

Worm problems can increase in severity with small farms, high stocking rates (especially where animals are picking at poor quality contaminated pasture), inadequate nutrition, too frequent drenching, too low drench dose rates, high rainfall areas, and buying in sheep with new or resistant strains or high burdens.

Implementation

Effective worm control relies on a three-pronged attack:

• Prevention
• Drenching
• Monitoring

Prevention

*General health and nutritional levels* - are the first priority. It has been observed that a healthy flock with acceptable body condition score and production for the time of lactation may nevertheless have a fairly high egg count. This may indicate *resilience* to worm burdens. However, the long term significance of this is unknown.

*Worm resistance* - there have been suggestions that sheep should be bred for *resistance* to worms. This is a long term possibility for a formal breeding program. It will naturally occur to a certain degree as animals are selected (or select themselves) for productivity and vigour, in systems that cannot afford to maintain problem animals. However, farmers cannot afford high losses of production in the meantime.

*Grazing management* - rotational grazing is a useful management tool for worm control. Most worms have been identified as being in the bottom 5cm of pasture, so grazing of fresh pasture of at least double that height should always be the aim. This is best achieved by strip or rotationally grazing pastures containing vigorous species that have been properly fertilised.

Apart from making maximum use of pasture feed, grazing on a rotation can reduce the number of larvae ingested, by sheep grazing the pasture tops. However, with highly productive pasture these general rules may be less effective. Some worm larvae may migrate much higher in moist growing environments.

Paddock spelling to reduce larvae numbers is usually ineffective in high producing areas due to the short length of rotations that must be used and to the fact that viable worm eggs persist in the soil and dung for many years.

Another form of grazing management that is used to reduce worm numbers in pasture is to graze paddocks occasionally with horses or cattle, which do not share most of the same worm species with sheep and can ‘clean up’ without re-contaminating.

Drenching

When done, this should be well done! Successful drenching relies on attention to the following:

• Ensure the drench will be effective by conducting a drench test (see Monitoring).
• Drench all ewes at a dose rate suitable for the heaviest ewe in the flock.
• Place the drench gun over the tongue to make sure the full dose goes where it is needed, ie. to the rumen. If given at the front of the mouth it may bypass the rumen and be much less effective.
• Apply drenches strategically to get maximum effect and to avoid frequent drenching, which results in drench resistance.
• For dairy goats, the CSIRO recommends a 2nd or 3rd dose of white drenches be given 12 hours after the 1st, especially if resistance is suspected. This may be appropriate for sheep also.
• Slow release drenches stop worms establishing, eg, Valbazen with extender pellets or bullets or capsules but could result in contamination of the milk if all ewes are treated at once due to a peak in the release of the chemical shortly after administration of the capsule.
• Yard "dry" stock the night before drenching to allow the animals to empty out prior to administration of a drench.

A suitable drenching program for SE and SW Australia is:
First Summer Drench (Nov-Dec) – to reduce the number of egg laying adult worms in ewes before the main summer dry period, when hot weather will help destroy worm eggs and larvae on pasture.
Second Summer Drench (Feb-March) – to further reduce the already low numbers of adult worms in ewes. The two summer drenches ensure that the autumn begins with low worm burdens in ewes and on pasture.

Autumn Drench (May-June) – to reduce the worm burden which tends to rise in autumn.
Winter Drench (Aug-Sept) – to reduce pasture contamination before spring, and may be the post lambing drench. Avoid drenching ewes heavy in lamb.
Weaning – unless weaning coincides with one of the summer drenches, lambs should be drenched at weaning.

Some farmers may prefer to monitor and drench according to the egg count results, rather than routinely.

Monitoring
Worm egg counts on dung pellets (faecal egg counts) are the surest way to determine drench requirement and effectiveness. Routine monitoring by this technique will eliminate unnecessary drenching and indicate the best drench to use. It is best done early in the morning, or at least at the same time of day, each time.

If the whole flock cannot be done, target groups can be determined in consultation with your vet, eg, a random 10% of the flock, excluding top and bottom 5%.

Agricultural department offices, private vets, private labs and stock agents can supply collection kits for worm egg counts, which are usually performed by a vet laboratory.
Drench requirements should be monitored 4 weeks after each strategic drenching, particularly after the autumn drench, to determine whether extra drenches are needed, and is best done on weaned lambs. Drench effectiveness is determined by comparing worm egg counts just prior to a drench, with those 10 days later.

**Withholding Period**

A withholding period (WHP) applies after use of drenches and some other veterinary chemicals to prevent residues being transmitted to consumers through milk or meat. Precautions are printed on drench containers and should be carefully followed. Residues are monitored in some States. Care should be taken when using veterinary chemicals at off label dose rates – the WHP published on the label is no longer applicable. Multiple treatments with the same product can also affect the WHP.

Note: ‘Off-label’ use is when a substance is used on a species, or in a way, that is not specified on the label, i.e., it is not registered for that purpose. Such substances may only be used under veterinary direction. Veterinary advice should be sought when off label treatments are given. Drenches for sheep may have a WHP for meat but not for milk.
5. Milking

5.1 Milking Premises Requirements

The first requirement for industry growth and development is high quality of milk supplied by farmers. Good product can’t be made from inferior ingredients. In a small industry producing specialty goods, the importance of this can’t be over-emphasized. Additionally, smaller volumes and less frequent milk delivery in the sheep milk sector are a risk factor that must be factored in. Consumers are becoming more sensitive to health issues, including microbes and residues. Flavour is an important issue with sheep milk and products.

There are differences between States’ requirements for milking premises but the basic aim is the same – good facilities are necessary for production of high quality milk.

Farm safety issues are important. Apart from risk of personal injury from badly designed or maintained premises, insurance and compensation issues may apply.

Siting

Discuss siting with your regulatory office (see Contact List at the end of this section) and other local environmental, planning and health authorities as appropriate. Premises should be easily accessible to stock, operators and any vehicles that may now or in the future require access, in all weathers. Free drainage from building, yards and tracks should be possible, and effluent disposal such as settling ponds should be conveniently located.

Access

You may need tanker access in the future, if not at present, and this could be a large vehicle. Some tankers can carry milk in separate smaller compartments and it is conceivable that sheep milk could be collected in such a vehicle. It’s best to allow for something like this at the planning stage as it may be expensive at a later stage.

The shed should be as close to the road as possible so the tanker access track can be short. Tankers may have difficulty with hills. Clear vision is necessary for the driver. Overhanging branches and other obstructions should be removed. Power lines must be well away from possible contact and clearly indicated. Allow good access to the milk vat and a suitable turnaround.

Keep stock off access tracks. The track should be soundly formed and drained. Consult a construction expert, e.g. a municipal engineer, for advice.

Services

Consider the availability of power and water when selecting the shed site.

Surroundings

These should be clean and free of pests, and of anything that might attract pests. The area should be free from offensive odours, e.g. from piggeries, manure heaps and dairy shed effluents.
Buildings, Yards and Facilities

The design and construction of the shed, yards, milk storage facilities and access tracks are important for ease of management and to minimise the time taken for milking and cleaning up.

Points to consider are:
- simple construction
- flexible design to allow for future changes/expansion
- good animal flow
- animal comfort
- operator comfort
- safety
- design of premises to enable milking to be completed in no longer than 1 ½ hours

Consult your local advisory officer for information and advice on shed design and construction. You should visit as many operating sheds as possible to see how they work, and how they could fit your requirements. It’s important to see the system in operation, and possibly participate in the milking to experience personally any problems, inconveniences or improvements that may be required.

Cow systems can be adapted easily for sheep. However, remember that a small animal can fit through or under a small space, and may attempt to do so especially whilst becoming used to a system.

Milk Room or Dustproof Compartment

- Allow enough space above a large vat for lid opening and dipstick clearance, and enough space between vat and walls for cleaning and servicing.
- Ensure adequate lighting so the vat can be easily inspected.
- Install protective covers on lights to prevent broken glass from getting in the vat.
- Seal the junction of each wall with both the floor and the ceiling.
- Install a water seal at the entry into the pipe for the drainage from the milk room to the milking area pit.
- Fit each door with a self-closing device.
- If windows can be opened, fit fly screens. Interior sills should not be present.
- Provide fly-screened ventilators in the walls and ceiling to disperse steam and allow the room to dry quickly.
- Provide an access door and clear passage for easy connection of milk transfer/tanker hose to the outlet of the vat.
- Construct a concrete apron with good drainage and provide a clean manure free area adjacent to the milk room for the milk transport vehicle.
- Ensure that drainage from the vat outlet does not flow under the vat.
- Provide adequate lighting outside the milk room for the safe collection of milk at night.
- Make sure there are good facilities, e.g. hot water easily accessible, and a well-drained apron, for cleaning the milk transport tank.
- Construct a concrete path to all entries to the milk room, including between milk room and milking area.
- Do not keep anything that is not used directly in the area, in the milk room. This includes antibiotic contaminated milk and colostrum.
- It is best to restrict the number of vats in the milk room for ease of milk collection and maintenance of good hygiene.
Milking Shed

- Should be well-ventilated, well-drained and well-lit.
- Finish the internal surfaces of walls with a smooth impervious surface to at least 1500mm above floor level.
- Finish floors with a non-slip free-draining surface sealed at the junction of the floor and walls.
- Internal walls, ceilings and roof under-surfaces should be constructed to exclude birds, rodents and insects, and to prevent build-up of dirt.
- Note that good surfaces and drainage, if not achieved satisfactorily in the first place, can be difficult to achieve later.

(See also Chapter 5.2 - ‘Milking Shed Design’)

Air Space and Engine Room

- Walls and floor should be waterproof and free draining.
- Fit machinery guards and other safety measures as required. Remember that farm machinery has a very poor safety record, and apart from personal injury, compensation issues apply.

Feed Bins and Storage

Feeders, troughs and feed bins in the milking shed should be:
- constructed of steel, galvanised iron, PVC or other impervious material
- kept clean and sound
- situated so that feed and dust from them cannot contaminate milk.

Do not keep brewers’ grains, silage or other wet feeds within 45 metres of a milking shed, unless in a flyproof impervious shed or bin that is:
- adequately drained directly to the holding yard effluent disposal system
- finished in a way that prevents breeding of insects and the possibility of the contamination or tainting of milk.

Holding Yards

- The yard should be of a sufficient size to hold the maximum number of sheep to be milked. A maximum of 3 ewes per square meter is suggested.
- Yards are often the same width as the shed, or funneled in to the shed, for better stock flow.
- Yard surfaces should be impervious to moisture, have a non-slip surface and adequate falls for drainage. A fall of between 1:30 and 1:50 allows for easy cleaning. The fall should be arranged so that the cleaner areas wash towards the dirtier areas, usually nearer the milking area. Twin falls may be used.
- Kerb the perimeters of yards and access ways to 150mm height to control effluent.
- Yard fences and gates should be constructed of steel, galvanised iron or equivalent material.
- The yard should be cleaned after each milking and maintained in good repair.
- Some sheep dairies have covered yards.
- Drafting, loading or holding facilities may be incorporated into yards.

Effluent Disposal

- Manure deposits should not be allowed to accumulate within 45 meters of the milk room.
- An effluent disposal system should comply with local environmental requirements. Farmers should contain dairy waste on their own properties and ponds should not be situated within 100 meters of any water source or water supply.
- Ponds are classed as fixtures and should be sited to comply with the requirements of local municipal regulations, which set minimum distances from road boundaries.
• Effluent ponds should not be sited within 45 meters of the milk room and should be kept as far away as possible from dwellings.
• Ponds should be of sufficient capacity to hold 3 months’ effluent and should be fenced to prevent access by children and animals.

Drainage Systems

All drains from the milking shed, milk room and holding yards should:
- be impervious, free draining, uniformly graded with a fall away from the milk room and milking shed so that all drainage discharges:
  - to a sump (to then be pumped or further discharged by properly constructed gravitational drains)
  - to a point at least 45 meters from the milk room and
- in the case of enclosed drains, have an internal diameter of not less than 150 mm.

All sumps used in the drainage system should be:
- equipped with a straining device or stone trap
- constructed to facilitate easy cleaning
- of such capacity to handle the maximum flow of effluent
- equipped with a gravity or mechanical effluent disposal system, and
- equipped with a storm water by-pass so as not to fill ponds with storm water.

Where a milk room is drained to a sub surface enclosed drain, the drain should be provided with a sanitary water seal (eg. ‘P’ trap) immediately adjacent to the drainage outlet in the milk room or a self closing flap at the drain outlet.
All sumps and drains should be maintained in a clean and sanitary condition and in good repair.

Toilet

Any toilet that is part of a milking shed should be:
- connected to a sewerage or septic system that conforms with the requirements of the local health authority
- vented to the open air
- not open directly into the milk room or milking shed
- inclusive of facilities for hand washing
A toilet cannot be connected to the yard effluent system under any circumstances.

Water Supply

An adequate supply of good quality (fit to drink) water is important for:
- washing udders and teats if this is needed.
- cleaning milking machines and bulk milk tanks, and
- use in hot water systems.
The quality of water is reduced by its bacterial content and its ‘hardness’.

The water bacteria which cause the worst problems are those that come from droppings, rotting vegetation and other decaying organic matter. The use of such water for washing teats or rinsing milking machines can lead to an increase in the bacterial content of the milk.

High levels of calcium or mineral salts in water cause ‘hardness’. Hard water reduces the effectiveness of detergents, increases scale and milk-stone buildup (which harbour bacteria), and can drastically reduce the life of a hot water system.
Rainwater in covered tanks where roof gutters are regularly cleaned, and water from a permanent stream are generally satisfactory for dairy use. Water from an underground bore should be analysed for its suitability, and water from farm dams avoided because of surface contamination and runoff. When choosing a source of water, or having a water analysis done, or treating water of inferior quality, assistance can be obtained from water supply authorities and local advisory officers.

**Hot Water Supply**

Hot water should be at least 90 °C for post milking sanitation. The size of the unit needed will depend on the number of sets of cups, and the pipeline and receiver capacities; the amount needed for washing the milk vat and the transport tank; and whether hot water is needed for other purposes, e.g., mixing lamb feeds and washing this equipment. A hot water allowance of 10L/set of cups per day is recommended, plus other requirements.

<table>
<thead>
<tr>
<th>Ewes</th>
<th>Sets of Cups</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>16</td>
<td>450 litres</td>
</tr>
<tr>
<td>150</td>
<td>22</td>
<td>600 litres</td>
</tr>
<tr>
<td>200</td>
<td>over 30</td>
<td>reverse flow (30L/unit/min)</td>
</tr>
</tbody>
</table>

Heater size will also depend on whether it uses off peak electricity. Supplementary solar heating is an option.

If water is to be drawn from the heater directly into the machines by vacuum or by pumping, a specially designed heater is required to avoid collapse of the unit during hot water draw-off. For safety reasons, special attention should be paid to all pipe connections where large volumes of hot water or detergent are drawn rapidly through the system.

**Safety at the Milking Shed**

Farmers should assess the risks at their milking sheds to ensure that a high standard of safety is maintained. Their responsibility is for the safety of family, employees, and the public.

**Buildings and Equipment**

If building or altering the dairy, consider the following safety features:
- Non-slip floors, and safety grooving of slippery floors.
- Provision of a room with a dry floor area that is safe for leaving children.
- Adequate lighting in milk room, passages, outside sheds etc.
- External switches near loading door for night loading of milk.

If you have a tall vat with a top mounted manhole, be careful when climbing onto the vat. There should be an internal ladder.

**Chemicals**

Use extreme care storing and using chemicals:
- Follow the recommendations on the container and store in a safe dry place.
- *Use of lockable storage cupboard for chemicals.*
- Take care when mixing chemicals; they can react and cause problems such as serious burns.
- Unskilled operators and children should never handle dairy detergents.
- Any product that may contaminate milk should never be stored in the milk room or milking shed.
- Chemicals that are no longer required must be disposed of appropriately. Contact your local council for information.
Drugs, especially Antibiotics

Use extreme care storing and using these.
- Follow the recommendations on the container and store in a cool dry place.
- Do not use antibiotics without veterinary advice.
- Drugs that are no longer required should be disposed of appropriately. Ask your local council.
- Do not use when out of ‘use by’ date.
- Note the withholding period and discard milk from all udder halves.
- Mark all ewes under treatment. Record their name/number, drugs used, and date that the milk can be used again.
- Give the full dose and for the recommended period of time.
- Take care when handling. Disposable gloves are ideal. Wash hands after using antibiotics.

With regard to these points, note that:
- repeated exposure to antibiotics (especially at a low level) can lead to the development of resistant strains of bacteria, resulting in that antibiotic no longer being effective in treating your livestock or your family.
- sensitivities such as contact dermatitis, and allergic reactions such as asthma, can also be a health risk.
- other drugs, eg, prostaglandins can cause serious reactions in humans.

Other Contaminants

The use of poorly preserved silage, of foods that may contaminate milk, or hay that contains soil could increase the bacterial count of milk, especially clostridia.

Electrical

State authorities have a wiring code that must be observed at all times.
- Always employ an electrical contractor to carry out alterations, repairs or additions to electrical installations.
- See that all wiring and equipment is well maintained.
- Do not overload wiring installations.
- Install an overload safety switch.
- Advise the local supply authority if additional equipment is being installed.
- Use weatherproof outlets and fittings in areas exposed to wind, rain or other moisture.
- Ensure that all earthing connections and covers over live conductors and terminals are firmly secured and in good repair.
- Install isolating switches.

Hot Water

Ensure that hot water taps are turned off firmly and are out of reach of children.
Do not carry hot water in plastic buckets.
For safety reasons, special attention should be paid to all pipe connections where large volumes of hot water or detergent are drawn rapidly through the system.

Leptospirosis

This disease is a problem in cow dairies. It can occur in sheep but the extent is unknown. Urine splashing, which is a common mode of infection in cow dairies, is less common with sheep.
Precautions suggested for cow dairies are:
- Vaccination of cows (not available for sheep).
- Always wear sound footwear.
- Handle aborted foetuses with rubber gloves.
- Reduce exposure of face, arms and body to urine splashing.
- After contact with animals, wash hands thoroughly with soap and water.

**Operating Equipment**

Protect moving parts such as pulleys, belts, shafts and augers. Milking machines and in-place cleaning systems should comply with the recommendations for safety standards set out in Australian Standard AS 2844.2 ‘Milking Machine installations – Construction and performance’.

These recommendations include:
- Keeping noise level as low as possible.
- Protecting equipment.
- Preventing a fire hazard developing from oil buildup.
- Installing electrical equipment to comply with legal wiring codes.
- Effective water protection of electrical equipment.
- Isolating switches where applicable.

**Milk Transport**

Remove all obstruction to the driver’s vision.
Ensure the safety of children in the presence of transport vehicles.

**Storage of Dangerous Substances used at the Milking Shed**

Store drugs, medicines, sanitisers, detergents, chemicals and sprays in a secure dry cupboard or room that is not accessible to children or unauthorised persons.

Further information:

**Dairy Food Safety Victoria**
PO Box 840, Hawthorn Vic 3122 ph: 03 9810 5900, fax: 03 9819 4299
info@dairysafe.vic.gov.au

**Tasmanian Dairy Industry Authority** 1895 Don Sandman PO Box 68, Hadspen, Tas. 7290
Ph. 0419 315 805
dsandman@tassie.net.au

**NSW Food Authority**
PO Box 6682, Silverwater NSW 1811 ph: 02 6552 300, fax: 02 6552 7239
contact@foodauthority.nsw.gov.au
5.2 Milking Shed Design

Design Criteria

Milking is one of the largest labour inputs on the farm. Common factors that affect time spent in the milking shed include:

- **Tracks:**
  - too narrow
  - sharp turns
  - poor surfaces
- **Holding yard design**
  - narrow yard entry
  - non-functional backing gate
  - slippery yard surfaces
- **Shed entry**
  - steep steps, ramps
  - lighting
  - blind corners
- **Shed exit design**
  - poor lighting
  - too narrow, or any obstructions
  - poor design of exit gates
- **Operator efficiency or insufficient number of milking units**
  - lacking routine
  - poor cup removal technique
  - waiting for ewes
  - exit gates not controlled from a number of points in the pit
- **Plant design and condition**
  - plant flooding
  - small diameter milk line
  - lack of adequate fall in milk line
  - faulty pulsation
  - poor cluster design
  - low vacuum (pump capacity)
  - faulty vacuum regulation
  - manual feeding system
- **Design of cleaning system**
  - inefficient cleaning system
  - slow draw-off water heaters
  - inefficient yard wash down equipment
  - poor surface drainage
Some objectives to consider in planning a new dairy shed include:
- what is the future of the farm?
- how many labour units is the shed being designed for?
- how long should be spent milking and cleaning?
- what size shed should be built? Number of units? Rotary or herringbone?
- management of dairy waste
- safety
- environmental, local government regulations and/or requirements

It is important to obtain advice from builders, dairy advisers, machine technicians, local authorities, and other farmers, and to observe sheds actually operating.

**Milking Shed Types and Features**

Key factors to consider in the design of a milking shed for sheep are:
- Average milking time per ewe is 1-1½ minutes, ie, much faster than most dairy animals
- Milking flock numbers will generally be much higher than for other dairy animals
- Allow for no more than two hours per milking
- Allow for future expansion of flock numbers

A herringbone design is common, double-up or swing-over, with ewes milked from behind. There should be enough units to keep the operator(s) busy (usually 12-24 units with 1-2 labour units). It is recommended that extra space be allowed for possible future increases in flock size. A double-up system, i.e., a set of cups for each ewe position available, milks out the flock quicker than a swing-over which shares sets of cups between two ewes, however, because of the short milking time per ewe this has to be balanced against the increased labour requirement. A shed with 24 stands and 12 sets of cups on either side can put through 150 ewes per hour with two labour units.

Highline or lowline systems are available, however lowline systems are considered better for udder health as less ‘lift’ is required to move the milk. Either a sunken pit or a raised platform, or a combination of these, may be suitable. If converting an existing shed a platform may be easier to install, especially if drainage is likely to be a problem. The convenience of the operator not having to climb in and out of the pit may be balanced against the slowing effect on ewe movement of ramps used with platforms. Cost of installation in a new shed may be higher for a platform depending on the relative costs of formwork for a pit, and steel fabrication for a platform. Footbath facilities at exits are important.

Ewes are spaced at 300-320 mm at 90 degrees angle to the pit, i.e 16 to 4.8 metres. Usual dimensions are 1200mm front to back of platform; rear to bails 900mm. If a right angle exit is used the distance should be about 550mm. A walkway around the platform is useful for drenching etc.

It is desirable that the platform and milk line slope in the same direction, about 1:60. Steps or ramps may be used if ewes need to walk up to the platform. These should be as gradual as possible. On-ramps should be at least 300mm wide. If too wide, several ewes may jam. Sheep mesh floor or industrial flooring can be used.

**Pit Design**

Points to consider regarding pit design include:
- the pit depth is critical to operator comfort. It may range from 800mm to 1 metre depending on the operator’s height. It is easier to adjust for a shorter than for a taller person.
- pit width is measured between the nib walls. It may be as little as 1200mm for one operator but more usually is 1500mm. It needs to be under 2000mm for a swing-over or the weight of
the cups on the udder will be too great and to-and-fro walking inconvenient. A doubleup pit may be wider.
- Swing-over width 1650mm to 1800 mm.
- doubleup width from 1800-2 metres.
- up to 300mm pit overhang to allow for equipment installation and protection.
- pit head should be at least 1800mm long with exit steps on both sides.

Herringbone Shed with Cascade Bails

**Bail Structure**

There is a diversity of restraining designs available. Cascade bails, cascade gates, rapid exit systems and several variations on head locking devices are used.
All bail and gate mechanisms should be operated from the pit.
Bails should have 100mm neck space when closed.
Bails usually have a division between them to stop ewes stealing food from each other. A flange 100cm wide and the height of the bail is suitable.
A kick rail is not needed for kicking but a breech rail is used by many for animal safety.

**Gates**

Backing gates may be used. Also, entrance and exit gates to the platform. Various gate designs such as sliding, swing, pendulum, and guillotine may be used.

**Rotary Dairies**

The number of ewes at which these become economical is not clear but probably over 500. Most need two operators. The design and function need to be closely investigated and they should be viewed in operation. A 32 bail rotary with two milkers and automatic cup removers can handle 400 ewes per hour.
Extra Features

Things that may be considered when planning a shed include:
- stall gates
- heating pit floor
- multiple hose connections
- drafting and AI facilities
- in floor drainage/submersible pumps
- colostrum lines
- large volume flood washing
- motion sensing lighting outside milk room
- toilet
- kitchen and shower facilities
- telephones/intercom
- computer facilities
- sheep mesh floor in holding yard to aid manure control and easy wash down.

5.3 Milking Machines

Select milking machines and equipment for which availability of parts and service is assured. Advice can be obtained from a local AMMTA (Australian Milking Machine Technicians Association) technician, Milking Research Centre or local advisory officer. These people may not always have specific knowledge of sheep milking, but understand the mechanics of milking, and have the knowledge and testing equipment to set your machine up correctly.

Selection, design and correct installation of machines is important so that:
- milking can be completed in about 1½ hours, irrespective of the number of ewes being milked
- the machines are capable of being extended if ewe numbers are increased.

Install machines so that pipelines and components can be easily dismantled for cleaning, inspection and servicing. Milking machines should be serviced on a routine basis at least annually to ensure satisfactory performance.
Vacuum Pump

Choose a pump with enough capacity for future increase in milking plant size. It should be located for easy access for daily maintenance, be protected from moisture (including weather) and where it will not create a noise problem. Safety guards should be fitted. Pump exhausts should be directed so that discharges will not create a nuisance to other equipment (e.g. condenser unit) or to traffic areas.

The vacuum pump continuously draws air from the machine and expels it to the atmosphere, which creates a vacuum in the machine. Air is admitted into the machine via pulsators, claw air admission holes, through the cups during cup changes and perhaps leaks. The pump needs to be capable of pumping sufficient air to maintain a stable vacuum in the machine at all times, so in addition to the normal air admission, reserve air is necessary to cater for such situations as cup falls. The reserve air enters the machine through the regulator. This is a valve mechanism that opens and closes as required to maintain a preset, stable vacuum in the machine.

Pump capacity tables are taken from the International Standards Organisation (ISO), and for sheep (including allowance for reserve air) are as follows:

<table>
<thead>
<tr>
<th>Number of Milking Units (Sets of Cups)</th>
<th>Required Pump Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 units</td>
<td>150 + 80 L/min per unit</td>
</tr>
<tr>
<td>&gt;10 units</td>
<td>950 + 45 L/min per unit</td>
</tr>
</tbody>
</table>

For example, 12 units would require pump capacity of 1040 L/min.

Vacuum Levels

The following parameters are a guide, but from observations it appears desirable to keep vacuum levels as low as possible for sheep:

- Highline: 42-44 kilopascals
- Lowline: 38-40 kilopascals

Vacuum Regulator

This should be matched to the pump capacity, be leak free and capable of maintaining the desired vacuum level in the milking machine.

Interceptor (Vacuum Tank)

The interceptor vessel (vacuum tank) should prevent moisture, milk residues, dirt and cleaning solutions being drawn into the vacuum pump, and provide adequate vacuum stability in the milk line. Interceptors should be provided with a self-draining valve. The interceptor should be easy to inspect, clean and sanitise.

Vacuum Gauge

Fit a vacuum gauge where it can be easily seen for checking that the pump and regulator are working properly. Check gauges for accuracy each time the machine is serviced.

Sanitary Trap

A sanitary trap between the milk system and the air system should prevent cross contamination. Part or all of the trap should be transparent. It should be self draining and easy to clean.
Milk Lines

Transport of milk from the claw may be via a highline or lowline system. Lowline is probably preferable because it can be operated at slightly lower vacuum levels, because no ‘lift’ is required and there are less friction losses because of shorter tubing. N.B. pulsators that will work at lower vacuum levels need to be used.

Milk lines should be installed above the ewes’ backs (but no higher than 1200mm above the platform) or below the level of platforms in a protected position. Entries should be welded expertly at the correct position and angle flush with the internal surface of the milk line to avoid milk flow turbulence. Bends for directional changes in milk lines should be kept to a minimum and be capable of being dismantled easily for cleaning and inspection.

Airlines

Airlines should:
- be of suitable material, e.g. stainless steel or food grade plastic
- be securely mounted and designed so as not to restrict free air flow
- have adequate fall towards the interceptor
- have a drainage valve at the lowest point in any change of direction upward
- be fitted with suitable inlets and removable plugs or caps at the ends of airlines to facilitate cleaning.

Pulsation

Pulsation is the action of the teat cup liner opening and closing on the teat. A pulsator is the device that causes this to occur. Pulsators are really valves and they cause the liners to move by alternately connecting the chamber of the teat cup (the area between the liner and the shell) to vacuum and atmospheric pressure and back again, and so on. Pulsation action gives relief by allowing the liner to collapse and apply pressure to the teat end and allows the release of milk from the teat.

Rate and ratio of pulsations

International standards specify pulsation to allow liners to be fully open for a minimum 30% (milking phase), and fully collapsed for at least 15% of the cycle with a limping phase (max) = 5%. To achieve these ISO pulsator specifications, a pulsator rate of approximately 120 cycles/minute is suggested at a 60:40 ratio. 60% is the liner opening, open and milking; 40% is the liner closing and closed on the teat. For safer pulsation it is suggested that the fully collapsed phase be a minimum of 20% of the cycle.
Diagram of Pulsation Action and Vacuum Phases

- **a** = increased vacuum phase
- **b** = maximum vacuum phase
- **c** = decreasing vacuum phase
- **d** = minimum vacuum phase

Milking Phase set at 60% (a + b)
Rest Phase set at 40% (c + d)

Operators should be aware of any changes to the speed and sound of pulsators during milking as any change could indicate an operating problem. Pulsators should only be adjusted by technicians who have the correct test equipment. They should be cleaned and maintained regularly.

**Flow Rates**

2 L/min milk flow rate from sheep is approximately the same as cows. Because this is only coming from 2 teats, it seems obvious that claw tube bores should be as large as possible and ideally no restrictions through the claw. Because the entries into the milk line need to be closer together than for cows, it is probably better to have larger rather than smaller milk lines with tangential entries. The present standard for cows is:

<table>
<thead>
<tr>
<th>Outside Diameter (mm)</th>
<th>Slope of Milkline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10mm/meter</td>
</tr>
<tr>
<td>38</td>
<td>6</td>
</tr>
<tr>
<td>51</td>
<td>12</td>
</tr>
<tr>
<td>61</td>
<td>18</td>
</tr>
</tbody>
</table>

**Milking Units and Claws**

Claws should be:
- fitted with large bore entries (min. 10mm) and outlets (min. 20mm)
- designed to prevent flooding
- stainless steel or food grade plastic
- of rugged construction
- able to be easily dismantled for inspection and cleaning

A cluster type bowl of min. 80ml capacity is recommended. The H claw with entries directly opposed may allow for cross contamination of milk between teats. Air admission holes are drilled in most claws and are necessary to maintain milk flow away from the cluster, release of vacuum at cup removal, and assist with the action of the liner. Air admission holes should be kept clear but not drilled out oversize.
Teat cup shells should be uniform in weight and length from cluster to cluster. If cow claws are modified for use in sheep welding must be of high quality with the internal surface flush to avoid milk flow turbulence. Costs of specifically designed sheep cups, and in particular liners, may be much higher than cow equipment, and farmers may consider suitable cow cups and liners as an alternative. Observations would suggest that some cups designed for sheep milking may not have sufficient length, which may result in teat damage (this applies to ewes with longer teats). This damage is caused because of blood congesting around the ends of the teats and blood vessels rupturing.

**Teat Cup Liners (Inflations) and Rubberware**

The teat cup liner is the only component of the milking machine to come into direct contact with the teat of the ewe. The important thing here is that liners are long enough to completely collapse beneath the teats and that they are matched to the correct cups for correct tension. A light longer shell and matching liner may be a more practical design for sheep. Heavy clusters may drag cups off. The mouthpiece of the liner must be comfortable for the ewe and not restrict milk flow. The effective length of liners is shown in the following diagram.

![Diagram of Teat Cup Liners](image)

Overall Length = \( L \) measured with liner in teat cup

Effective Length = \( EL \) calculated as \( EL = L - IL \)
This should be 14 cm or more

Ineffective Length = \( IL \) measured with liner removed from teat cup

To reduce possible problems from overmilking it is suggested that fewer units be handled by each operator towards the end of the season. Flow controlled cup removers will also help to prevent overmilking.

Liners and rubberware should be changed as advised by the manufacturer or as soon as any faults are detected. Damaged liners and rubberware cannot be cleaned properly, and bacteria in cracks can reduce milk quality and increase the risk of total cell count failures and mastitis infections as well as cause damage to the base of the udder.

**Milk Receival Vessels**

A range of equipment is in use for removing milk from the machine and transferring it to the vat. A spit chamber releaser is suitable for small highline machines, but a receival vessel and milk pump will be required for large machines. The receival vessel should be made of high-grade stainless steel, glass or food-grade plastic, or a combination of these materials. It should be located where it can be easily dismantled for inspection and cleaning, and if located in the milking shed, where it will be clear of splashing. Large receival vessels should be fitted with can flushing devices.
Milk Pumps

These should have sufficient capacity to cope with increases in milk production and may be of diaphragm or centrifugal impeller type.

- Diaphragm pump speed should not exceed 50 strokes/minute. The pump should be cleaned and drained after each milking and the diaphragm rubber replaced as soon as any fault is detected.
- Centrifugal pumps should be controlled by a probe switch which operates to activate the pump when the milk level in the receival vessel rises to a predetermined level and is fitted with a milk flow control device to assist cooling.

Filters

A filter should be fitted to catch unavoidable sediment such as wool, dirt, dust or other extraneous matter from the milk, and is necessary when a plate cooler is fitted. Filters should be large enough to handle the pump pressure and volume of milk applied to them. Filters should be changed after each milking. If reusable nylon types are used, they should be cleaned and sanitised after each use. Fine pad type filters can be used in spit chamber release systems.

Where milk is to be pumped, suitably large sock type filters should be fitted:
- between the milk pump and the bulk tank, or
- between the milk pump and the plate cooler

Coolers

Substantial cost savings can be achieved by pre-cooling milk, and also the warmed water may be useful for udder washing where this is practiced. A flow control device can be fitted to the centrifugal pump to allow continuous running during milking to maximise cooling efficiency. Where plate coolers are installed, an appropriately sized filter should also be installed on the milk inlet side and it is recommended also to filter the water supply system.

Milk coolers should be cleaned regularly to:
- maintain cooling efficiency
- maintain the quality of the milk
- reduce the operating costs of the bulk milk tank refrigeration.

The cooler should be dismantled, inspected and manually cleaned if necessary when milk quality problems occur or if the milk filter sock bursts during use. Care must be taken when reassembling to avoid damage to the rubber gaskets. Do not over-tighten.

Milk must be cooled to less than 5 °C no longer than 3½ hours from the start of milking. Sheep milk may require cooling rapidly to lower temperatures to reduce bacterial activity because of infrequent milk pickup/delivery.

Releaser

This is a common method of releasing the milk from the system. The diagram gives an example of the operation of a typical spit chamber releaser.
A. Spit chamber at atmospheric pressure. Inner flap closed.
B. Spit chamber under vacuum. Inner flap opens.
C. Spit chamber at atmospheric pressure. Outer flap opens, milk is released.

**Test Buckets**

Test buckets are individual receptacles for milk that is to be kept separate from vat milk. These vessels and associated rubber ware should be kept clean and in good repair. Unclean and unsound test buckets can cause milk quality problems.

**Milk Testing Equipment**

Milk testing equipment supplied for use on farm by a milk testing unit should be inspected for cleanliness whilst being fitted to the milking machine. The microbiological quality of the farm milk can be adversely affected by the use of unclean equipment. It should be clean before use and cleaned afterwards.

*Further information:*
Countdown Downunder: Farm Guidelines (Victoria)
5.4 Milking Management

Routine

Milking is customarily done twice a day, mornings and afternoons, with a recommended 9-15 hour interval between milkings. Once a day milking is reported to reduce total yields by around 25%, although this may be contemplated towards the end of lactations when yields fall below 1 litre per day.

![Typical lactation curves of highly productive East Friesian ewes (black dots) and their crosses with local Merino (white dots)](image)

It is important to have a set routine for each milking, being as gentle and quiet as possible with the ewes to avoid release of adrenalin which blocks oxytocin, the let down hormone. Sheep may be rewarded with feed in the bail, which helps train them, keeps them quiet and allows feeding of concentrates if required.

Sheep milk out quickly compared to most other dairy animals, in 1½ minutes or less, so it is necessary to have a system whereby teat cups can be changed over from ewe to ewe without undue delay. Leaving cups on too long contributes to udder damage and mastitis.

Overseas dairy sheep have two distinct types of milk ejection patterns:

a) Some eject their milk in two peaks, corresponding to the milk accumulated in the udder's cisterns, and to the alveolar milk released following the action of the let down hormone oxytocin. This second peak occurs within 30 seconds of the first.

b) Others have only one peak corresponding to the cisternal milk. Little oxytocin is produced, so these sheep effectively do not have a milk ejection reflex. As a consequence, they are never milked out completely and the milk accumulating between milkings partially inhibits further milk secretion resulting in shorter lactations and reduced total lactation yields.

Since the alveolar milk has a greater fat content than the cisternal milk the type of ejection pattern also affects the composition of milk, and therefore its processing performance. Milk ejection patterns differ among different breeds of sheep: in general double ejection patterns are more frequent in breeds specialised for dairy production. In the Awassi, a breed highly selected for milk production, the milk ejection reflex is so rapid that the two peaks occur almost concurrently and are superimposed onto each other resulting in the detection of a single large peak.
Once imported to Australia, the Awassi sheep were crossed with local breeds and their milk ejection patterns have not been studied. Current research is investigating if these milk emission patterns are associated with the sheep’s behaviour and temperament. If sheep are tested for milk composition it should be relatively simple to detect ewes that do not have a milk let down because they will have low fat milk.

Some farmers claim that sheep have a double let-down and need mechanical stripping or double cupping. However, this has not been substantiated by current research. Mechanical stripping normally achieves the removal of more milk because it improves the drainage of the udder into the milking cups and effectively counteracts the cup-crawl, where cups that are too light crawl up the teat and partially block the flow of milk.

**Ewe Identification**

Accurate identification is needed for effective flock management, including breeding and health issues. It is especially important when ewes have been treated with drugs such as antibiotics that have a withholding period. Paint marking may assist in temporary identification for these purposes but cannot assist ongoing management.

The system used should be easy to read in the paddock, and in the shed or yards. Various systems are used, including ear tags, tags on neck collars, write-on neck collars, leg straps and electronic implants. Herd test organisations recommend tattoos or small brass ear tags as a backup for the above. Ear tags survive better if they do not hang down below the ear.

If the ears of the sheep are not visible during milking, forms of identifications that are detectable from the back (e.g. anklet or temporary tags attached to the wool of the rump) should be considered.

**Udder Preparation**

Udder and teats should be clean and dry before teat cups are put on. Teats and udders that are visibly clean are best not washed. Dust may be brushed off. Use clean running water and ensure the whole washed area is dry before milking commences. Dirty water running back down, is likely to contaminate teats worse than they were before washing. Crutching can reduce dirt in the area. A mud free environment, in particular well formed laneways, will keep contamination to a minimum.
Mastitis

Mastitis is an inflammation of the udder resulting from infection. Mastitis is described as ‘clinical’ when there are actual signs of infection such as lumps in the milk, discoloration or watery fluid, or when there is swelling, hardness or heat in the udder. ‘Subclinical’ mastitis has no outward signs.

Both can be caused by the same bacteria and can damage the udder, reduce milk production and affect the quality and quantity of dairy products. Mastitis can be spread during milking by the milker’s hands and through milking machines. (see Chapter 4.9)

5.5 Cleaning & Sanitising Equipment

Milking Equipment

Equipment with milk contact surfaces should be cleaned after each milking. Components that are difficult to clean should be inspected daily to ensure that their surfaces are clean.

Milking Machines (manual cleaning)

1. After each milking, scrub all residues from the exterior of the teatcups, claws, drop tubes and rubbers with a warm solution of alkaline detergent and water.
2. Turn off plate cooler water supply.
3. Cold water rinse; draw at least 10 litres of cold or warm water through each cluster into the machine.
4. Remove and clean the milk filter. If a plate cooler is in use, replace the filter for the remainder of the cleaning process.
5. Detergent wash (temperature of water and amount of detergent as recommended by the manufacturer on the label of the detergent container). Draw at least 5 litres through each set of cups. Raise each cluster clear of the liquid and lower it back into the liquid a number of times to obtain a turbulent action during this process. It is generally recommended that:
   a) acid be used in the morning and alkaline at night, or
   b) alternatively alkaline 12 times and acid twice per week.
6. Final rinse: draw at least 5 litres of water at a temperature of at least 90 °C through each cluster as a final rinse.
7. After the final rinse, run the machines under vacuum for 2 minutes prior to shutdown to remove moisture from the vacuum pump and to leave it re-oiled.
8. Withdraw all plugs and releaser flaps and open all drain points to permit air drying between milkings, and
9. Dismantle and manually clean the releaser if required.
**Milking Machine** (cleaning in-place)

Use a low to medium-foaming general purpose detergent suitable for circulation cleaning. Medium to high-foaming detergents may produce excessive foam during circulation cleaning. The basic cleaning-in-place procedures, variations of which may be required in specific instances, are:

1. Follow the steps set out in paragraphs 1, 2, 3 and 4 of Milking Machines (manual cleaning) procedure.
2. Remove and separately clean those items that cannot be effectively cleaned by circulation cleaning, or that restrict the velocity (flow) of the cleaning solution.
3. After the machines have been arranged for circulation cleaning, circulate with a cold rinse followed by a cleaning-in-place detergent at a temperature:
   a) of 60-80 °C when an alkaline general purpose detergent is used, or
   b) of 80-90 °C when an acid detergent is used.

**NOTE:** Filling the machine will reduce the effect of heat loss and minimise the load on the detergent solution.
4. Circulate the detergent cleaning solution for approx. 3 minutes, allowing the first 10 litres to run to waste. If the temperature of the solution at the outlet of the return line falls below 60 degrees C, circulation should be discontinued as redepositing of milk residues may occur. Maintain sufficient flow and turbulence in the pipeline (e.g. by using a surge valve) to ensure effective cleaning.
5. Discharge the detergent cleaning solution from the circuit, and
6. Draw hot water (at least 90 °C) from the intake through the machines to waste. Do not recycle this water.

**Milking Machines** (‘Bomb’ cleaning)

Machines should remain in a clean condition if the twice daily routine cleaning system (manual or cleaning-in-place) is working effectively. If there is a breakdown in the effectiveness of the routine cleaning system the plant can be ‘bomb’ cleaned. However ‘bomb’ cleaning should never be adopted as a routine cleaning procedure. If it is found to be necessary, then the overall methods and procedures in use must be examined to determine the cause of the recurring problem.

Operators using insufficient water volumes, inadequate water flow rates, incorrect detergents and detergent use, coupled with blocked jetters and insufficient plant vacuum can cause the problems to persist. ‘Bomb’ cleaning can be seen as a solution to end all problems that, in reality, may be the result of poor general cleaning routines or faulty equipment. If high bacteria counts persist as a result of unclean machines, advice should be sought from local advisory officers.
‘Bomb’ cleaning of milking machines

Purpose of ‘bomb’ cleaning is to:
• remove build-up of milkstone deposits
• clean up of equipment at the start of a new season, and
• assist in solving problems with build up of bacteria

Steps to follow are:
1. Set up the Jetter cleaning system for circulation or, if not available, use a hose to form a circulation line. Ensure water temperature is above 90 degrees.
2. Flush system with hot water to heat components.
3. Circulate heavy duty ACID detergent for 3-4 minutes (200gm/10litres).
4. Use a flushing pulsator or pull a plug regularly to create turbulence.
5. Flush out acid detergent with clear hot water.
6. Circulate a CHLORINATED ALKALINE detergent for 3-4 minutes (200gm/10litres). Use sponges through lines and hand scrub the receival vessel after this wash is run to waste.
7. Rinse all equipment with ample hot water.
8. Check and brush all parts if necessary. Replace perished rubberware.

Note: If milk stone deposits are only slight, steps 3 & 4 could be deleted.

**Milking Machines** (reverse flow systems)

Reverse flow cleaning is a fast effective method of cleaning if used twice a day using recommended flow rates, quantities of liquids and temperatures. However, reverse flow is considered to be less cost effective and less efficient than the jetter systems because of the quantities of liquids used and the shorter contact times involved. Talk to a dairy adviser for more detail on reverse flow systems.

**Airline System**

To ensure freedom from taints, the vacuum system should be inspected, cleaned and sanitised regularly if it is not included in normal daily cleaning. Where airlines are connected via a sanitary trap directly to the milk receiver or releaser, these lines should be cleaned and sanitised daily.

**Bulk Milk Tank** (manual cleaning)

1. Hose out the bulk tank with water at a temperature not exceeding 50 °C so that the direct expansion unit is not damaged by heat;
2. Clean the bulk tank and its accessories (including the outlet) with suitable brushes and a solution of general purpose detergent; and
3. After the tank and equipment have been cleaned, rinse with clean sanitised water to remove all traces of the detergent solutions.
Bulk Milk Tank (cleaning-in-place)

Carry out this procedure according to the routine advised by the manufacturer, and also inspect regularly to determine the need for periodical manual cleaning.

1. Hose out the tank with water at a temperature not exceeding 50 degrees C as soon as the transfer of milk to the milk tanker has been completed;
2. Remove and manually clean the plug, thermometer, agitator and those items that cannot be effectively cleaned in-place and, after cleaning, replace them in position;
3. Arrange the circuit for recirculation and clean the tank by circulating a low-foaming general purpose detergent at a temperature not exceeding 50 degrees C; and
4. Drain the system, and rinse the tank with clean sanitised water.

5.6 Antibiotics & Chemical Residues

Milk must be kept free of antibiotics and chemical residues.

- Residues in milk can occur from:
  - intramammary and intramuscular treatments for mastitis
  - antibiotics or other drugs used, e.g. footrot treatment
  - drenches or injections for parasites (worms, etc.)
  - dips and sprays for lice
  - teat dips and ointments
  - dairy sanitisers, detergents and cleaners
  - contaminated feeds and grains treated with pesticides
  - sprays used for insects on pasture crops and irrigation channels.
- Antibiotics and agricultural chemicals that cause residues in food and animals are required to have a recommended withholding period information label on the package or container.
- Read the directions on the label carefully to determine the exact withholding period. If in doubt contact a veterinary surgeon.
- Mark all ewes being treated with drugs.
- Record ewe number, drugs used, date treated and date that the milk can be put into the bulk milk tank.
- Always observe the recommended withholding period for the chemical or drug used.
- Ensure that you are aware of the withholding periods if a veterinary surgeon uses drugs in treating an animal.
- Discard milk from both udder halves for the withholding period when using intramammary treatment.
- Use cleaning chemicals strictly in accordance with instructions.
- Ensure that weed or pasture sprays are not kept or mixed in the milk room or in any equipment that may come into contact with the milk or cleaning materials.
- Never refill empty chemical containers with a product to be used for cleaning milking equipment.
- Store drugs in a closed and secure cupboard away from the milk room.
- Do not graze ewes on pesticide treated pasture or crops until the recommended withholding period has elapsed.
- Notify the factory immediately if it is suspected that antibiotic or inhibitory substance contaminated milk has been supplied.
- Ensure that contaminated milk is not collected and mixed with other milk in a farm collection tanker.

Note that due to the small volumes involved with sheep milk, any residues are proportionally a greater problem than they may be in cows milk, and greater care therefore needs to be taken.

Note also: ‘Off-label’ use is when a substance is used on a species, or in a way, that is not specified on the label, i.e. it is not registered for that purpose. Some drugs are not registered for use on ewes and detection of these residues can carry legal liabilities. Such substances may only be used under veterinary direction.
References


“Pasture Management for Dairy Farmers”. Target 10 Handbook, Victorian Department of Natural Resources & Environment

“Nutrient Composition of Feeds”. NSW Agriculture.

“The National Primary Production and Processing Standard for Dairy Products” (Standard 4.2.4 of the Food Standards Code).

“ANZDAC Guidelines for Dairy Farms” (available from State regulatory authorities).

“Code of Practice for Dairy Farms” (available from State regulatory authorities).

Countdown Downunder: Farm Guidelines.

“Successful Worm Treatment”. CSIRO


This Manual is intended as a guide to current recommended dairy sheep farm management practices based on observations and information gained during the course of the project. It is expected that the guidelines will be useful for both present and prospective dairy sheep farmers.

Domestic interest in Australian sheep milk products has been growing steadily since the 1960s and consumer demand generally exceeds supply according to trade sources. There has been solid growth in demand for sheep milk yoghurt in the marketplace via specialty food stores and supermarkets. Even more promising is the increasing interest in the European style specialty cheeses made from sheep milk such as feta, ricotta, haloumi and pecorino together with local types of fresh, white mould and blue cheeses. Smaller operators tend to concentrate on cheese production.

Export opportunities do exist due to a world shortage of sheep milk products. However, such markets usually demand a regular supply of relatively large quantities of product. Any attempt to meet this international demand should be based initially on the establishment of a sound and cost effective domestic industry.

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