A guide to grazing systems and animal production

Kylie Woodgate

Western Australian Department of Agriculture

Australian Wool Innovation Ltd.
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A guide to grazing systems and animal production.
Foreword

Agriculture in Western Australia is an exciting and challenging business, which contributes very significantly to the economy of Western Australia. Our farmers and their supply chains compete on an international level with the best farmers throughout the world.

To be competitive, farmers must manage their business excellently and be fully aware of new and improved technologies for managing their resources and business in a sustainable way. It is important that agriculture continue to attract young and talented individuals to be the next generation of managers and industry service personnel. Moreover, these individuals need to be skilled at a very high level to meet the demands and challenges of the future.

In this context, Agriculture Western Australia is very pleased to contribute this manual towards the development of these skills. It makes available to teachers, students and the wider community, information on animal production systems important to the future of agricultural businesses in Western Australia. This manual will provide an important bridge to the range of information, advice and services provided by Agriculture Western Australia to the industries in this state. I am sure that this manual will contribute to the ongoing success of agriculture in this state.

Dr Graeme Robertson
Chief Executive Officer
Agriculture Western Australia

G.A. Robertson
CHIEF EXECUTIVE OFFICER
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Introduction

This manual has been produced as a joint venture between the Wool and Meat Programs of Agriculture Western Australia. It is intended to provide current information on most animal production issues today.

It has been modified from the current Woolpro and Prograze manuals distributed to farmers and is designed for use mainly by Agricultural Colleges and Secondary Schools teaching Agriculture. It should be used in conjunction with these manuals.

This manual is intended for use as a teaching aid, available to teachers, and is not intended as a textbook. All the information contained in this manual may be copied or reproduced for use by students or as handouts provided by teachers. All exercises may be used and/or modified by teachers.

The information in this manual is current and correct at the time of printing and is in line with practices being recommended through Agriculture Western Australia. It is intended that the manual will be periodically updated as circumstances and recommendations change.

If, in conjunction with this manual, the school wishes to conduct its own on farm evaluations, Agriculture Western Australia Woolpro may be able to supply advice.

For further information contact Tom Plaisted at Agriculture Western Australia Albany office Phone – (08) 9892 8499
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Anatomy of Sheep
Anatomy of Cattle
Classes of Stock
Sheep and Cattle Handling
Main Animal Husbandry Events
Condition Scoring
Ruminant Digestion
Nutritional Requirements of Ruminants

ACTIVITIES
Bolus – food chewed and mixed with saliva
Cellulose – highly fibrous carbohydrate content of plant cell walls
Dock – to remove a tail
Elastrator rings – thick elastic bands used to remove testicles and tails
Gestation – period from conception to birth
Joining – the period of time that male and female animals are put in the same paddock to mate
Libido – desire of animal to have sexual intercourse
Micro-organisms – tiny organisms that can only be seen with the aid of a microscope, these include bacteria, protozoa and fungi.
Muster – to collect a group of animals together
Regurgitate – to return food to the mouth from the stomach
Ruminant – animals that have four stomachs and are able to digest a high proportion of cellulose eaten.
Vaccination – an injection of a vaccine to produce immunity to a disease
Sheep within a flock are classified into groups according to their age, gender and/or purpose.

- **Lambs**: a young sheep from birth to weaning
- **Weaners**: a young sheep that has been removed from its mother until about one year old
- **Hoggets**: a sheep from about 15 months of age until two years old
- **Wethers**: male sheep that have been castrated
- **Maiden ewes**: female sheep that have not yet had a lamb
- **Ewes**: adult female sheep that have given birth to a lamb
- **Rams**: adult male sheep that are entire

Cattle within a herd are also classified into groups according to their age, gender and/or purpose.

- **Calves**: young animals from birth to about 10 months of age
- **Vealers**: calves reared on milk and grass to be slaughtered at about 8 to 12 months of age
- **Weaners**: young animals from weaning to about 12 to 15 months of age
- **Yearlings**: young animals from about 12 months of age to 24 months of age
- **Steers**: male cattle that have been castrated
- **Heifers**: female cattle that have not yet had a calf
- **Cows**: female cattle that have had at least one calf
- **Bulls**: male cattle that are entire and sexually mature
Sheep
It is important when handling sheep to plan activities so that the animals are not injured or stressed, and that the person handling the sheep is not injured. Quality assurance issues, such as the prevention of bruising of the muscles, and animal welfare issues should be kept in mind when handling sheep.

When moving or mustering sheep make sure that all gates are opened or closed as required prior to beginning, if this is possible. Muster the sheep into a mob and move them at their pace, guiding them from the rear. Sheep generally tend to move away from people, so try not to stand in front of them if you want them to move in that direction. It is useful to use trained dogs to help control the mob.

When sheep are brought into yards ensure that there is sufficient room for them to comfortably move and stand. If sheep are left in yards for any period of time they should have access to clean water. When sheep are in a race they should have enough room to breathe and stand. Be careful as sheep in a pen tend to move away from people and dogs in yards which can lead to crushing of some sheep, especially small lambs against fences.

Cattle
As with handling sheep, it is important to plan activities so that the cattle are not injured or stressed, and the person handling the cattle is not injured. There are quality assurance issues, such as the prevention of bruising of the muscles, and animal welfare issues that should be kept in mind when handling cattle.

When moving or mustering cattle make sure that all gates are opened or closed as required prior to beginning, if this is possible. Muster the cattle into a mob and move them at their pace, guiding them from the rear making sure not to move too close to the cattle as they may then break away from the mob.

It is easiest to handle cattle when they are in a yard, particularly in a crush. Don’t overcrowd yards and races as the animals must be comfortable and able to breathe. Always approach the animals quietly and make sure they are aware of your presence. To avoid being kicked try to work outside the animal’s kicking range or directly against the animal.

Remember that cattle are larger and more powerful than people so always take care to protect yourself when handling cattle.

Refer to Farmnote no. 60/90 ‘Handling Cattle’ for more detailed information.
There are a number of routine activities that are carried out by farmers raising sheep and cattle. The time when each activity is performed varies across districts depending on the local climate and individual farm management programs to reach production goals.

For example, the climate determines pasture growth (and therefore feed availability), when it is too hot for rams and bulls to mate and when rain is expected, causing worms to hatch on the pasture.

Sheep

i) Mating – (also called joining) the time of mating should be decided after considering the condition of the pasture and temperature when the ewes would be due to lamb. It is important that there is sufficient green feed just before lambing, and for a few weeks after lambing, to meet the nutritional requirement of the ewe at this time. When the temperature is very hot, a ram’s fertility can be reduced and both the ewe and ram have a lowered libido.

ii) Lambing – the gestation period for sheep is 150 days. A close watch should be kept on ewes due to lamb and help should be given to any ewe needing it. Lambs must be protected from predators, such as foxes, and kept warm (sheltered paddocks help to protect lambs from the effects of the wind).

iii) Marking – lambs are marked at about six weeks of age. This involves earmarking the lamb with the registered mark to identify which property it comes from. Earmarks are in the right ear for ewes and the left ear for rams. Ram lambs that will not be used for breeding are castrated. This is commonly done by placing elastrator rings (thick elastic bands) at the top of the scrotum, with both testicles in the scrotum; or by cutting the scrotum and removing the testicles. The lambs’ tails are also docked. They are either cut off or an elastrator ring is placed on the tail. Lambs can also be mulesed which involves cutting a strip of skin from each side of the base of the tail and down the backs of the thighs. As the wound heals the remaining skin stretches across this area reducing the number of wrinkles in the skin, reducing the area that remains moist and attracting less flies to the sheep. The lambs are also given their first vaccination for clostridial diseases, cheesy gland and scabby mouth (for export lambs). (Refer to Segment 4)

iv) Weaning – lambs are commonly weaned from their mothers at three to five months of age. They should be weaned onto a clean paddock (refer to worm control in segment 4) that has shelter, a good water supply and lush green feed that is not too long. Lambs should be given a booster vaccination shot when they are weaned.

v) Crutching – the wool is shorn from the breech - over the tail, around the pizzle (in rams and wethers) and down the back legs. The wool in these areas is often wet by urine and faeces making it an ideal environment for blowflies to lay eggs, which then causes flystrike. By reducing the presence of flies, less chemicals are required for control therefore less chemicals are present on wool at shearing thus improving quality.

vi) Shearing – shearing is usually done by shearing teams contracted by the farmer. The sheep are mustered in their mobs and bought close to the shearing shed. Shearers shear the whole fleece which is then skirted (all the stained wool is
removed), classed and placed in a bin with other fleeces of the same type. As each bin fills, the wool is pressed into bales.

**vii) Drenching** – sheep should be monitored for the presence of worms and, if required, drenching should be carried out. A drench is a chemical mixture that kills parasitic worms that live in the rumen and intestine of the sheep. Once they are drenched they should be placed in a ‘clean’ paddock. Refer to Worms and Worm Control in Section 4 for more detailed information.

**viii) Dipping** – covering the sheep with a specially formulated insecticide to kill lice that may be living in the wool and on the skin of the sheep. Sheep can either run through a shower or be plunged into a pool or dip to swim through. In both cases it is critical that the whole sheep is wetted through to the skin surface with the chemical, to ensure contact with lice. ‘Pour-on’ products that are applied to each individual sheep are also available. Refer to External Parasites in Segment 4.

**ix) Jetting** - this involves running sheep through a race and showering them with a liquid insecticide to protect the sheep from flystrike. This is only a short term solution to flystrike as the insecticide only lasts a few weeks. Be aware of withholding periods and residues in fleeces. Refer to Quality Assurance in Segment 3.

### Cattle

**i) Mating** – (also called joining) the time of mating should be decided after considering the condition of the pasture and weather conditions when the cows would be due to calve. It is important that there is sufficient green feed just before calving and for several weeks after calving to meet the nutritional requirement of the cow. When the temperature is very hot, a bull’s fertility can be reduced and both the cow and bull have a lowered libido.

**ii) Calving** – the gestation period for cattle is about 280 days. A close watch should be kept on cows due to calve and help should be given to any cow needing it.

**iii) Marking** – calves are usually marked from about three months of age. This involves earmarking the calf with the registered mark in the right ear to identify which property it comes from. A tag may also be placed in the ear to enable cross referencing with herd records. Registered studs often use an ear tattoo to identify individual animals. Bull calves that will not be used for breeding are castrated. This is commonly done using elastrator rings or by cutting the scrotum and removing both testicles. Calves may be branded with a registered brand of the owner. This is usually done by restraining the calf in a branding cradle then firmly pressing the hot branding iron onto the skin. The calves are given their first vaccination for clostridial diseases and possibly leptospirosis. Refer to Important Diseases of Cattle in Segment 4.

**iv) Weaning** – calves can be weaned from their mothers from five to six months of age. They should be weaned onto a clean paddock (refer to Worms and Worm Control in Segment 4) that has a good water supply and lush green feed. Calves should be given a booster vaccination about four to six weeks after their first vaccination.

**v) Drenching** - cattle should be monitored for the presence of worms and, if required, drenching should be carried out. A drench is a chemical mixture that kills parasitic worms that live in the rumen and intestine of the cattle. Once they are drenched they should be placed into a clean paddock. Adult cattle are mostly immune to worms, so drenching is rarely required. Refer to Worms and Worm Control in Segment 4 for more detailed information.
Condition scoring requires you to feel the amount of fat and muscle cover over the backbone and first short rib to assess the animal’s condition. Fat is the main tissue in this location and is therefore a good indicator of general fattiness of the animal and the condition of an animal is affected by nutrition, health and/or stress.

There are two main reasons to condition score stock. The first is to assess whether more feed is needed to maintain or increase the animal’s condition. The second reason is to determine whether the animal meets carcase requirements for particular end markets. In most cases this is more reliable than liveweight as condition scoring is not affected by the amount of feed in the intestines, pregnancy and other such variables.

**Sheep**

To condition score a sheep it should be standing in a relaxed position. Locate the last rib and using the balls of fingers and thumb, try to feel the backbone with the thumb and the ends of the short ribs with the fingertips. Feel the muscle and fat cover at the ends of the bones and the fullness of the eye muscle, this determines the condition of the animal (diagram on Activity Sheet on page 14).

Condition scores in sheep range from 1 to 5. They are independent of body weights, so small lambs and fully grown wethers can have the same condition score. One condition score change is usually worth about seven kilograms of weight difference in a mature sheep.

Descriptions of condition scores are:

1. The ribs feel sharp and the eye muscle feels thin and hollow, the sheep is very thin
2. The ribs feel rounded and the eye muscle feels flat
3. The ribs can be felt with firm thumb pressure and the eye muscle feels rounded
4. The ribs can be felt with very firm thumb pressure and the eye muscle has a covering of fat
5. The ribs cannot be felt with very firm thumb pressure and the muscle cannot be felt because of a thick layer of fat, the sheep is very fat

For more information and pictures of condition scoring sheep refer to Farmnote 69/94 “Body condition scoring of sheep and goats”
To condition score cattle it is best to have it standing in a relaxed position in a race or crush. Locate the last rib and using the balls of fingers and thumb, try to feel the backbone with the thumb and the ends of the short ribs with the fingertips. Feel the muscle and fat cover at the ends of the bones and the fullness of the eye muscle to determine the condition of the animal.

The fat cover at the head of the tail should also be felt. This can be done by using the balls of your fingers and trying to feel the amount of fat cover over the top of the tail bone.

Condition scores in cattle range from 1 to 5:

1. The ribs are sharp to touch and there is no tail fat. The hip and ribs can be seen. The animal is very thin.
2. The ribs feel rounded and there is some fat cover at the tail head.
3. The ribs can be felt with firm thumb pressure and areas each side of the tail head have fat cover that can be easily felt.
4. The ribs cannot be felt and fat cover at the tail head can be easily seen.
5. The ribs can no longer be seen at all and the tail head is almost completely buried in fat. The animal is very fat.

It is common practice now to measure the eye muscle area in cattle using an ultrasound machine.

For more information on condition scoring cattle refer to http://www.nre.vic.gov.au
Sheep and cattle are ruminant animals which means they have four stomachs. They feed on bulky, fibrous foods that an animal with only one stomach (called a monogastric) would not be able to digest. The cellulose in the fibrous food is broken down by bacteria and other micro-organisms that live in the rumen (or first stomach).

The ruminant digestive system is made up of the following parts:

The parts of the digestive system all work together so that the animal can get as many nutrients from its food as possible. This is how it works:

1 – The animal chews the food in its mouth. The saliva in the mouth contains enzymes that start to break down the food and also moistens the food (now called a bolus) to help it slip down the oesophagus to the rumen.

2 – The bolus enters the rumen where it is churned and mixed with the juices there. Bacteria and other micro-organisms ferment the food, breaking it down into smaller particles. Some of the bolus is regurgitated (cud) and chewed again.

3 – Once the food particle size is small enough it passes into the reticulum, which looks like honeycomb. Any food particles that are too large are pushed back into the rumen to be further broken down. The food is broken down further by the chemicals in the reticulum as well as the physical contractions of the walls.
4 – The omasum has folded mucous membranes that are tightly packed together so that they look like the pages of a book (it is also called the bible). The food here has up to 70% of the water removed and is also ground into tiny pieces.

5 – The food passes into the abomasum where gastric juices kill and digest microorganisms that are still in the food. The abomasum is similar to a human stomach.

6 – The food moves into the small intestine. Bile and other digestive juices are added to help in digestion and absorption of food.

7 – The small intestine is lined with tiny finger-like projections that absorb simple food substances into the bloodstream. These substances (such as amino acids and simple sugars) are taken to the liver which sends them to where they are needed in the body.

8 – Any food material that has not been absorbed moves on to the large intestine, which absorbs as much water from the food as possible. This waste material is then stored until it is expelled through the rectum as faeces.

(Pictures sourced from Feeding Plans for Sheep Learning Guide (RUA AG4402 SW) Agriculture Training Package RUA 98)
The food that animals eat is the fuel that gives them the energy and nutrients to live, grow and produce wool and meat. Animals have five groups of nutrients that must be included in their diet to allow them to function normally.

The groups of nutrients are:

a) Protein – these provide the animals with the building blocks for every cell in their body. Proteins are chains of amino acids that are broken down in the animal during digestion. The amino acids are absorbed into the bloodstream and taken to the part of the body where they are required and then built back into proteins again. Protein can be found in young leafy pasture (as pasture ages the protein content decreases) and supplements such as grain and fish meal. Legumes are a major source of protein.

b) Carbohydrates – these provide the animal with most of its energy. Carbohydrates are made up of different forms of sugars and include cellulose. Ruminants are the only domestic animals that can make use of the carbohydrates found in cellulose. Carbohydrates are found in all plant material.

c) Lipids (fats) – these provide the animal with concentrated forms of energy and helps the body to absorb some vitamins. Lipids are found in plant material and in supplements such as molasses. Large amounts are found in legume grains such as canola and lupins.

d) Minerals – these are salts that are required for normal growth and regulation of body functions and contribute to the structure of tissues and organs in the animal’s body. They can be found in plants and if lacking in an animal’s diet can be supplemented using intra-ruminal pellets, fertiliser and licks. The main mineral deficiencies in Western Australia include selenium, cobalt, calcium and copper.

e) Vitamins – these are organic compounds that are required in small amounts for the normal functioning of animals. Two important vitamins are Vitamin A and D. Vitamin A is required for bone development and maintenance of sight. Vitamin D is required for calcium and phosphorous absorption in the body. Important sources of vitamins are sunlight and green plant material.

Water is also essential. Forming more than 70% of an animal’s body. It is used in cells for chemical reactions, to help move food through the digestive tract and in blood and lymph to help with the transport of substances around the body. Animals should have a constant supply of clean water.

The specific nutritional requirements of an animal will also be influenced by factors including age, gender, condition and physiological status. For example pregnant and lactating females have a dramatically increased demand for energy and protein. Younger animals also have large demands for nutrients as they are actively developing and growing rather than just maintaining body size and condition.
Quietly bring a small group of sheep, preferably weaners, into the sheep yards. Move them into a small yard (for example, a shearing catching pen).

Carefully approach the sheep and guide them to a corner of the yard. Wait until they are standing quietly and select one.

Standing on one side of the sheep, gently lean one leg just behind the sheep’s front leg and your other leg on the rump of the sheep.

Hold the sheep’s muzzle and turn it away from you and into the body of the sheep. This should put the sheep off balance, so you can then roll the sheep towards you and onto its back.

Hold the sheep on its rump with its back leaning on your legs and grip the sheep’s front legs to prevent it moving.

While you have got the sheep quietly on its rump have a look at its teeth.

How many teeth does it have?

Identify the following parts of the sheep:

- pastern
- muzzle
- withers
- shoulder
In this activity you will be assessing the condition score of several sheep and deciding whether they meet market specifications.

1. Select 8 sheep at random and put them in a race. Divide the class into three or four groups.

2. Select one of the sheep. Make sure that it is relaxed. Feel the fat cover over the ribs and backbone using your thumb and fingertips as shown in the diagram below.

Source: Farmnote No. 69/94

Remember

- bone feels hard  
- fat feels soft  
- muscle feels firm

3. Assign a condition score (between 1 and 5) to the sheep. Place the condition score in the appropriate row of the table.

4. Repeat steps two and three for the remaining seven sheep. Each group should condition score each sheep separately.

<table>
<thead>
<tr>
<th>Market Specifications</th>
<th>Condition Score of Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sucker Lambs</td>
<td></td>
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<tr>
<td>C.S. 2</td>
<td></td>
</tr>
<tr>
<td>Live Export Wethers</td>
<td></td>
</tr>
<tr>
<td>C.S. 2-3</td>
<td></td>
</tr>
<tr>
<td>Finished Lambs</td>
<td></td>
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<tr>
<td>C.S. 3</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
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</tbody>
</table>
Condition Scoring

Teacher Focussed Discussion Questions

1. Were the condition scores appropriate for this time of year and class of animal? Why?

2. Were the condition scores given to each sheep consistent throughout the class?

3. If any differences did occur, why do you think differences in condition scoring has occurred?

4. What would be a useful way of overcoming differences between people in their allocation of condition scores?

5. What would you recommend the farmer do with the sheep that did not meet market requirements?
Sheep Husbandry Events Activity

Following is a list of husbandry activities that are usually carried out on a farm producing sheep. For each activity write a short description of how and why it is done.

<table>
<thead>
<tr>
<th>MONTH</th>
<th>HUSBANDRY EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>SHEARING, JOINING</td>
</tr>
<tr>
<td>February</td>
<td>JOINING, CRUTCHING</td>
</tr>
<tr>
<td>March</td>
<td>DIPPING, CRUTCHING</td>
</tr>
<tr>
<td>April</td>
<td>DIPPING, CRUTCHING</td>
</tr>
<tr>
<td>May</td>
<td>CRUTCHING, LAMING</td>
</tr>
<tr>
<td>June</td>
<td>LAMING, DIPPING</td>
</tr>
<tr>
<td>July</td>
<td>LAMING, CRUTCHING</td>
</tr>
<tr>
<td>August</td>
<td>JOINING, CRUTCHING</td>
</tr>
<tr>
<td>September</td>
<td>DIPPING, CRUTCHING</td>
</tr>
<tr>
<td>October</td>
<td>DIPPING, CRUTCHING</td>
</tr>
<tr>
<td>November</td>
<td>DIPPING, CRUTCHING</td>
</tr>
<tr>
<td>December</td>
<td>DIPPING, CRUTCHING</td>
</tr>
</tbody>
</table>

Now list the husbandry activities on the calendar below showing when you think each activity should be carried out on a farm in your local area and give reasons for your choice:
Cattle Husbandry Events Activity

Following is a list of husbandry activities that are usually carried out on a farm producing cattle. For each activity write a short description of how and why it is done.

<table>
<thead>
<tr>
<th>MONTH</th>
<th>HUSBANDRY EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>JOINING</td>
</tr>
<tr>
<td>February</td>
<td>MARKING</td>
</tr>
<tr>
<td>March</td>
<td>CALVING</td>
</tr>
<tr>
<td>April</td>
<td>DRENCHING &amp; JETTING</td>
</tr>
<tr>
<td>May</td>
<td>WEANING</td>
</tr>
<tr>
<td>June</td>
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<td>July</td>
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<td>November</td>
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<tr>
<td>December</td>
<td></td>
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</tbody>
</table>
1. Sheep and cattle require a balanced diet which includes which six groups of nutrients?

2. Do young animals require more or less protein than mature animals?
   Why?

3. Ruminants are animals that can make use of cellulose as a source of carbohydrates. Why is this?

4. Vitamins A and D are the most important vitamins in an animal’s diet. What function do they have?
This Section

Soil Characteristics
Fertilisers
Pasture
FOO (Feed On Offer)
Dry Sheep Equivalents
Stocking Rates
Animal Feed Requirements
Feed Budgeting
Supplementary Feeding
Feedlotting
Feed Conservation
Grazing Strategies
Insect Pests of Pasture
Water Quality and Availability
Landcare Issues

ACTIVITIES
**KEYWORDS**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaerobic</td>
<td>containing no oxygen</td>
</tr>
<tr>
<td>Annual</td>
<td>plant completing it’s lifecycle within a season</td>
</tr>
<tr>
<td>Awn</td>
<td>long bristle like attachment to a seed covering</td>
</tr>
<tr>
<td>Fermentation</td>
<td>the breaking down of materials by micro–organisms in an anaerobic environment</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>any product that adds nutrients to the soil</td>
</tr>
<tr>
<td>Hay</td>
<td>dried plant material that is fed to animals as supplementary feed</td>
</tr>
<tr>
<td>Infiltration</td>
<td>the movement of water from the soil surface into the soil</td>
</tr>
<tr>
<td>Maintenance ration</td>
<td>a diet with an energy and nutrient content sufficient to allow the animal to survive without gaining or losing weight.</td>
</tr>
<tr>
<td>Nematode</td>
<td>round worms, some of which are parasitic in animals</td>
</tr>
<tr>
<td>Oestrogen</td>
<td>a female hormone</td>
</tr>
<tr>
<td>Ped</td>
<td>the smallest structural unit of soil</td>
</tr>
<tr>
<td>Perennial</td>
<td>plant that continues it’s growth from year to year</td>
</tr>
<tr>
<td>pH</td>
<td>a measure of acidity or alkalinity</td>
</tr>
<tr>
<td>Pinnate</td>
<td>tiny finger like projections that make up leaves</td>
</tr>
<tr>
<td>Pore</td>
<td>the space in the soil between peds</td>
</tr>
<tr>
<td>Production ration</td>
<td>food with an energy and nutrient content above maintenance to allow the animal to grow and produce (eg. grow wool, produce milk, put on weight or to produce a calf or lamb)</td>
</tr>
<tr>
<td>Prostrate</td>
<td>growing close to the ground</td>
</tr>
<tr>
<td>Silage</td>
<td>plant material that has been harvested while green and fermented, then fed to animals as supplementary feed</td>
</tr>
<tr>
<td>Transpiration</td>
<td>the evaporation of water from the leaves of plants</td>
</tr>
<tr>
<td>Tufted</td>
<td>leaves and stems growing closely together</td>
</tr>
<tr>
<td>Tussock</td>
<td>growing in a large clump</td>
</tr>
</tbody>
</table>
Soil Characteristics

The type and fertility of soil directly influences the type of pasture that can be grown and the quality of that pasture. As pasture is what the animals eat to meet their nutritional requirements, the soil beneath that pasture is very important.

Soil has five main components:

- **Mineral particles** - clay, sand and silt
- **Organic matter** - dead and decaying plant and animal material, this is like a glue that helps to hold the mineral particles together
- **Water** - contains dissolved nutrients that the plants use for their growth
- **Air** - the gases found in the spaces between soil minerals
- **Living organisms** - includes micro-organisms such as bacteria and invertebrates such as earthworms

The proportions of each of these five components influence the physical properties of soils.

*A dark Loamy duplex*
SOIL CHARACTERISTICS

Physical properties

a) Soil structure - this is the arrangement of the mineral particles in the soil. The smallest unit of soil is called a ped - this is made up of mineral particles held together by organic mater and chemical bonding. The way in which these peds are arranged is known as soil structure.

The arrangement of peds determines the size of spaces or pores between them. These pores either contain air or water. Without air or water available to their roots, plants cannot grow.

Soil structure therefore dictates the amount of air and water there is in a soil. This influences the water infiltration, strength of a soil and it’s erosion potential.

Cultivating soil can easily change the soil’s structure as the machinery physically breaks up the soil peds and the weight of the tractor compacts the soil reducing or removing the spaces between the peds. Overgrazing can also change the structure of a soil. The weight and number of animals compacts the soil (in a similar way to tractors) reducing the pore space between the peds. As stock eat the pasture down they reduce the soil cover which can allow erosion (removing the fertile topsoil).

b) Soil texture - this is the proportion of sand, silt and clay in a soil. Soils are usually named by their texture. Sand is the largest of the soil minerals. A sandy soil has little structure and a poor ability to hold water but good aeration.

Silt is the middle sized soil mineral. Silt is a very fine mineral particle size, slightly coarser than clay. Because of the age and development of soils in Western Australia, silt isn’t a dominant particle size. However, soils which are smooth and have a soapy or fluffy feel may contain silt sized particles.

Clay is the smallest of the soil particles. A clay sandy soil can have good structure with many pores that hold water and air but this is easily destroyed by cultivation making the soil prone to waterlogging.

c) Water Holding Capacity - is the ability of the soil to retain water for plant growth. As plants can be up to 90% water, the water that they lose through their leaves because of transpiration must be replaced by taking water out of the soil by the root system. The smaller the size of the soil pore, the more difficult it is for the roots to obtain water. The larger the pore, the quicker the water drains through the soil, therefore limiting the available water for plant growth.

Water enters the soil through the soil surface by infiltration. Water can be removed from the soil by draining down the soil profile, evaporation from the soil surface and uptake by plants.

When all the soil pores are full of water, the soil is saturated. After 48 hours when some of this water drains away, the soil is said to be at field capacity.

After reaching field capacity, plants and soil organisms remove water from the soil until physical forces holding water in the pores no longer allow water to be removed. This is called the wilting point of the soil because the plants can no longer replace the water they lose in transpiration and wilt.
The following diagram shows the changes in the amount of water in the soil:

- **SATURATED SOIL**: water loss because of drainage
- **FIELD CAPACITY**: water taken up by plants
- **WILTING POINT**: water evaporated from soil
- **AIR DRY SOIL**: water evaporated from soil

**d) Soil pH** - this is a measurement of the acidity/alkalinity of the soil. It is important because it influences the availability of nutrients to be used by plants.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Neutral</th>
<th>Alkaline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreasing availability</td>
<td>Nitrogen</td>
<td>Decreasing availability</td>
</tr>
<tr>
<td>Rapidly decreasing availability</td>
<td>Phosphorus</td>
<td>Decreasing availability</td>
</tr>
<tr>
<td>Rapidly decreasing availability</td>
<td>Potassium</td>
<td>Available</td>
</tr>
<tr>
<td>Decreasing availability</td>
<td>Sulfur</td>
<td>Available</td>
</tr>
<tr>
<td>0</td>
<td>pH 7</td>
<td>14</td>
</tr>
<tr>
<td>Rapidly decreasing availability</td>
<td>Calcium</td>
<td>Slowly decreasing availability</td>
</tr>
<tr>
<td>Rapidly decreasing availability</td>
<td>Magnesium</td>
<td>Slowly decreasing availability</td>
</tr>
<tr>
<td>Slowly decreasing availability</td>
<td>Zinc</td>
<td>Rapidly decreasing availability</td>
</tr>
<tr>
<td>Rapidly decreasing availability</td>
<td>Molybdenum</td>
<td>Available</td>
</tr>
</tbody>
</table>

Most plants grow best in a soil that has a neutral pH. If the soil is too acidic, lime can be incorporated into the soil to raise the pH, if too high sulfur can reduce the alkalinity.

In Western Australia problems with acidity are more likely to be encountered than problems with alkalinity.
ALL SOILS

n
Wet or water logged at <50cm for the major part of the year

y
Wet soils

n
Rocky or Stony or coarse gravelly (>20%, >20mm) throughout

y
Rocky or stony soils

n
Ironstone gravel layer (>20%) occurs within top 15cm, & gravels a dominant feature

y
Ironstone gravelly soils

n
Sandy topsoil (at least 3cm thick)

y
Sandy-surfaced soils

n
Loamy topsoil (at least 3cm thick)

y
Loamy surfaced soils

n
Clayey topsoil (at least 3cm thick)

y
Clayey-surfaced soils

n
No suitable group

Note: Soils that do not clearly key out into a soil group should be classified as No suitable group (Minor soils in Western Australia)
Key out the soils according to their dominant criteria
FERTILISERS

Soil fertility is vital to pasture production, and to maintain adequate levels of nutrients, fertilisers may be added to the paddock. As fertilising is an expensive activity it is best to get a soil and/or plant tissue test done to determine if any nutrients are deficient and need to be applied to the paddock.

Soil tests are a chemical analysis of the levels of soil nutrients and the pH of the soil (to find out if lime is needed). Soil test reduce the guesswork involved in fertiliser use, as they tell you what levels of nutrients are present, allowing you to monitor fertility levels in the paddock and identify reasons for poor plant performance.

Tissue tests complement soil testing as they give you a guide to the levels of micronutrients, which are not currently assessed in soil testing. Tissue tests are performed on leaf samples of actively growing plants and tell you the nutrient needs of the pasture or crop at the time of sampling.

Once this has been done use the results to work out the type of fertiliser that are required. It is best to apply fertiliser in small amounts regularly rather than in occasional large amounts, however this is largely impractical. Large amounts of fertiliser can burn plants and, where there is excess of nutrients, some may dissolve in the water in the soil and drain away (nutrient run-off).

Soil pH

It is also important to consider the pH of the soil as adding fertiliser can reduce the pH (making the soil more acidic) and affecting the plants’ ability to take up the nutrients. Soil pH is one of the most useful and commonly measured chemical indicator of soil health as it determines the solubility and reactivity of many soil elements such as aluminium and manganese.

Soil pH is usually measured in a dilute solution of calcium chloride. In Western Australia, the ratio of soil to solution is 1:5.

The problem with low pH soils is that they cause the release of aluminium (a common element of Western Australian soils) which inhibit’s root growth at high concentrations. In the eastern states of Australia, manganese is more common and can have a similar effect on plant growth.

To overcome the problem of soil acidity, lime can be added to increase soil pH. The effectiveness of the lime depends on it’s neutralizing value and the particle size of the lime. To increase the pH of the soil by one pH unit, about one tonne of lime per hectare needs to be added to the soil. In most cases, when the soil pH falls below 4.8, farmers will add one to two tonnes of lime per hectare per year until the soil pH is increased to the level they require.
Soil Nutrients

There is a range of nutrients that are required by plants to grow and produce seed. Different soil types will have different naturally occurring levels of each of these nutrients, with some naturally deficient.

Sixteen elements are considered necessary for growth. They are divided into two categories – macronutrients and micronutrients. Macronutrients are all essential, required in large amounts and are usually the first to become deficient.

Nitrogen (N) is required by all plants to make proteins.

Phosphorus (P) is an essential component of plant cells.

Potassium (K) is used for photosynthesis, plant internal water balance and seed production and is often deficient in sandy soils.

Sulfur (S) and magnesium (Mg) are secondary nutrients, required at lower levels by plants. Sulfur is an essential nutrient for nitrogen fixation in legumes, while magnesium is involved in photosynthesis.

In Western Australia, the macronutrients calcium (Ca) and magnesium (Mg) are usually supplied by the soil.

Micronutrients are required by plants in small or trace amounts but are just as important as the macronutrients. The four mentioned below are the most important as they occur naturally at very low levels in Western Australian soils.

Copper (Cu) is used for the activation of enzyme systems in plant cells.

Zinc (Zn) is used in some enzyme functions.

Manganese (Mn) is an essential part of photosynthesis of the plant and also activates some enzyme systems.

For further information refer to the “Australian Soil Fertility Manual”.

Manganese (Mn) is an essential part of photosynthesis of the plant and also activates some enzyme systems.
A fertiliser is a product that adds nutrients to the soil.

Manufactured fertilisers are produced synthetically in factories. These fertilisers contain nutrients that are readily taken up by plants.

Organic fertilisers are derived from the decomposition of plant or animal materials. The nutrients are slowly released by microorganisms in the soil to be taken up by plants. These have an advantage of adding organic matter to the soil which can help to improve soil structure.

When choosing the type of fertiliser to use the soil type, rainfall, soil pH, pasture composition, nutrient content of the fertiliser and price per kg of nutrient should all be considered.

For further information refer to Woolpro Reference Manual Segment 1, p13 “Fertiliser and Stocking Rate”.
Pasture is the mix of grasses, legumes and broadleafed plants that animals graze. Most pastures are “improved”, which means that they contain plant species that have been sown by the farmer for improved nutritive value. As native grasses tend to have a low nutritive value for sheep and cattle, new species of grasses and legumes have been selected and bred for Australian conditions.

Grasses are upright plants with long tapering leaves, they tend to provide animals with roughage, energy and bulk feed. Legumes have many heart shaped leaflets making up their leaves, five petalled flowers and nodules on their roots which “fix” nitrogen (convert nitrogen from a gas in the soil to a form that the plant can utilize) and they are a good source of protein and energy for animals. A good pasture mix has at least 40% legumes. (See activity sheet for pictures of each.)

Like all plants, pastures have growth cycles. These growth cycles vary according to rainfall and temperature. Higher annual rainfall means a longer growth cycle producing more feed. (Refer to Figure 1 Segment 3, page 11 of the Woolpro Reference manual for a graph depicting this trend.)

Pasture is more nutritious for the animals when it is green, because animals are able to digest a greater percentage of the pastures they eat. Flowering plants have a higher fibre content and a lower protein content. The following figure shows how digestibility of grasses decreases as they grow.

**Digestibility changes as the pastures grows**

![Digestibility Graph](image)

Source: Prograze
Some of the more common pasture species found in southern Western Australia are described in this section. Within each species there will be varieties that may have characteristics that vary slightly from those described here.

### Annual Pasture Species

Annual pasture plants only grow for one year. Towards the end of the year they flower and then set seed. This seed can then become the ‘seed bank’ in the soil to germinate in the next favourable season. In this way annual pasture plants can be self regenerating.

### Grasses

**Ryegrass** (*Lolium rigidum*) - a tussocky, leafy grass. The leaves are dark green and glossy. It is most productive during winter and early spring. It requires a minimum of 300mm rainfall and grows best in soils with a pH of 4.5 or above.

It is a highly nutritious grass. Care must be taken when animals are grazing annual ryegrass as it can become infected with a fungus that produces toxins that are toxic to stock causing ‘ryegrass staggers’.

**Barley Grass** (*Hordeum leporinum*) - a tussocky grass with leaves up to 20cm long. The leaves are light to medium green in colour and lightly hairy. It requires a minimum of 350mm annual rainfall and grows best in soils with a pH of 4.5 or above. It is commonly a self sown pasture plant.

It is a highly nutritious grass but the awned seeds it produces can puncture the skin or cause irritation to the mouth, nostril and eyes of grazing stock and also increase the vegetable matter percentage in wool. The seed heads can be removed by spray topping the pasture. Barley grass can be an indicator of waterlogging and mild salinity.

**Soft Brome** (*Bromus hordeaus*) - a loosely tufted grass with long leaves. The leaves are grey green and covered with short hairs.

### Legumes

**Subterranean Clover** (*Trifolium subterraneum*) - it grows close to the ground and has green leaves with a hairy underside. It grows well in winter and spring and responds well to grazing. Subterranean clover is so named because it produces seed by burying it’s burrs underground. There are cultivars that grow in annual rainfall areas from 250mm to 700mm.

It is a highly nutritious plant but the leaves of some of the cultivars contain a form of oestrogen that can cause infertility, pregnancy and birthing problems in ewes. New cultivars of subterranean clover are available with lower oestrogen content of the leaves.

**Balansa clover** (*Trifolium michelianum*) and **Persian clover** (*Trifolium resupinatum*) are both able to grow in waterlogged, mildly saline soils in medium and high rainfall zones. Balansa clover can tolerate slightly more acidic soils (down to pH 4.5), while Persian clover prefers pH 5.0 to 5.5. Both species provide high quality dry feed to stock in early summer.
Medics (*Medicago spp.*) play a similar role to subterranean clovers but are generally suited to soils of a higher pH (above pH 5.0). There are a range of species (barrel medic, strand medic, disc medic, burr medic) and cultivars that are adapted to high, medium and low rainfall zones. While they look quite similar to subterranean clover, they have yellow flowers (instead of white flowers) and produce seed above the ground.

Seradellas (*Ornithopus spp.*) were relatively recently introduced into Western Australia. There are two common species grown in Western Australia - Yellow serradella (*Ornithopus compressus*) and French serradella (*Ornithopus sativus*). Yellow serradella grows close to the ground and has pinnate green leaves. It grows very slowly over winter and grows best with a minimum of 350mm annual rainfall, although varieties have been bred to suit different rainfall zones.

French serradella (*variety Cadiz*) has become very popular as it is 98% soft seeded and the seeds will germinate in the pod, providing a cheap pasture that will grow in high and medium rainfall zones on deep acidic soils. It is best sown with Yellow serradella to ensure regeneration after cropping or summer rainfall.

Serradella is a highly nutritious plant with deep roots that allow it to access subsoil moisture so can continue growth longer than subterranean clover in spring.

In addition to those annual pasture legumes mentioned above, there are a number of newer alternative legume species that have been released by CLIMA (the Centre for Legumes In Mediterranean Agriculture):

Crimson Clover (*Trifolium incarnatum*) is a large seeded clover species with large dark green leaves and bright red flowers. It is suited to the greater than 500mm rainfall zone.

Arrowleaf Clover (*Trifolium vesiculosum*) is a large seeded, deep rooted variety that is a good summer grazing option. It is suited to medium and high rainfall zones.

Biserrula (*Biserrula spp.*) is a very hard seeded species that will tolerate deep sands and heavy grazing situations. It is not suited to areas that receive any waterlogging and will grow where annual rainfall is above 375mm.
Perennial pasture plants tend to grow from season to season. They do need to be resown into a pasture for at least five years, unless they become dominated by annual and/or legume pasture species.

Perennial pastures are becoming increasingly popular as they have deep root systems and have the potential to use more water, preventing recharge of groundwater tables.

**Grasses**

Perennial Ryegrass (*Lolium perenne*) - a densely tufted and leafy grass. The leaves are dark green and glossy. It is most productive during spring and autumn although it does grow well during winter. It requires a minimum of 600mm annual rainfall and grows best in soils with a pH of 4.5 or higher.

It is highly nutritious for stock. Care must be taken when animals are grazing perennial ryegrass as it can become infected with a fungus that produces toxins that are toxic to stock causing ‘ryegrass staggers’.

Cocksfoot (*Dactylis glomerata*) - a tussocky grass with long leaves. The leaves are greyish to bright green with rough margins. It is productive during autumn, winter and spring but dormant over summer. It requires a minimum of 450mm annual rainfall and grows best in soils with a pH of 4 or above.

It is quite nutritious for stock but not as nutritious as ryegrass.

Kikuyu (*Pennisetum clandestinum*) - a low growing (prostrate) grass that spreads by runners. The leaves are dark green. It is most productive during spring and autumn. It requires a minimum of 500mm annual rainfall and grows best in soils with a pH of 6 or above.

It is not a highly nutritious grass and is best when legumes are also present in the pasture. Rare cases have been reported of kikuyu poisoning in sheep and cattle although the cause is not known. Symptoms of kikuyu poisoning include staggering, salivation, grinding of teeth and depression.

**Legumes**

Lucerne (*Medicago sativa*) is a low growing perennial shrub that can provide year-round feed. It requires a minimum of 300mm rainfall and is best in soils of pH 5.5 or above where there is no waterlogging. There are a number of cultivars that grow more actively, in either winter or summer.

Tagasaste (*Chamaecytisus proliferus*) is a perennial fodder shrub suited to deep sands. It is at its highest quality in winter and spring but can still provide a quality feed to cattle and sheep year round. For optimum production shrubs should be cut to maintain a low many-stemmed plant. (Refer to Farmnote 50/2000 “The feed value of the perennial fodder shrub tagasaste”.)
Warm Season Fodder Crops

Fodder crops are also increasing in popularity as they provide an out of season feed source. To be successful, these warm season crops need access to moisture during summer and autumn. Care should be taken when grazing fodder crops as there is the risk of poisoning from young or stressed crops.

Examples of common fodder crops include:

Forage sorghum is the best known and most popular summer forage crop. It is relatively drought tolerant but needs soil temperatures of 16°C or more to germinate.

Millet (Japanese, Shirohie and Siberian types) can be sown earlier in the year, when soil temperatures are above 14°C.

COMMON WEEDS IN PASTURES

Capeweed (Arctotheca calendula) grows close to the ground and has yellow flowers on stems up to 15cm high. The leaves are green with large teeth. The plant smothers pasture species by growing flat, over the top of them and preventing sunlight from reaching them.

Stock readily eat capeweed and it has some nutritional value for them. If it dominates their diet it can cause nitrate poisoning.

Also known as Cape Dandelion.

Corkscrew/ Wild Geranium (Erodium botrys) - it grows to about 40cm high and has green leaves that are lobed and slightly toothed. It has pink flowers. Stock readily eat this plant and it has no known ill effects.

Also known as Storksbill.

Flatweed (Hypochoeris radicata) - it has leaves (up to 15cm long) that grow close to the ground and stems that can grow 80cm high bearing a yellow flower. Stock readily eat the plant.

Also known as Catear and Dandelion.

Patterson’s Curse (Echium plantagineum) - it grows to 1.2m and has green leaves and purple flowers in spring. It can grow on most soil types. The young plant smothers out seedlings of pasture plants.

Sheep and cattle will eat the young plants before they develop stems, which are covered in bristles. It is not thought to have a high nutritive value. Patterson’s curse can cause poisoning in sheep (particularly Merinos) when they eat it over two seasons. It is a declared plant in some parts of Western Australia.

Also known as Salvation Jane and Purple Bugloss.
FOO stands for feed on offer. It is an estimate made by farmers of all the above ground plant material, both green and dry.

It is primarily used by farmers to help make decisions on stocking rates and the need for supplementary feeding.

Knowing how much FOO is available in a paddock is the first and most important step in being able to work out stocking rates and feed budgets.

When you combine this with the Pasture Growth Rates, and animal requirements you can calculate stocking values, grazing days and complete feed budgets.

More detailed information about why and how to assess FOO can be found in the Woolpro Paddock manual on page 9, Prograze Segment 2 and Prograze Appendix 1.

**FOO (Feed On Offer) =**

**COMPOSITION**

(the mix of grasses, legumes and other species in the pasture)

**HEIGHT**

(the height of the pasture)

**DENSITY**

(how closely the plants are growing together)
Dry Sheep Equivalent (or DSE) is a measure of the feed requirements of a two year old 50kg wether to be able to maintain its body weight. It is calculated as an average feed requirement over a whole year, allowing for fluctuations in pasture growth.

DSE is commonly used as a unit of measurement for the comparison of the carrying capacity (number of sheep or cattle) of different properties.

It is usually given as a figure of DSE per hectare.

<table>
<thead>
<tr>
<th>Class of Animal</th>
<th>DSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Ewe</td>
<td>1.0</td>
</tr>
<tr>
<td>Wether</td>
<td>1.0</td>
</tr>
<tr>
<td>Ewe &amp; Lamb</td>
<td>2.5</td>
</tr>
<tr>
<td>Weaner/Hogget</td>
<td>0.8</td>
</tr>
<tr>
<td>Working Ram</td>
<td>1.2</td>
</tr>
<tr>
<td>Dry Cow</td>
<td>6.0</td>
</tr>
<tr>
<td>Steer</td>
<td>6.0</td>
</tr>
<tr>
<td>Cow &amp; Calf</td>
<td>13.0</td>
</tr>
</tbody>
</table>

Stocking rate is the number of stock carried on a paddock over a period of time. It is usually calculated as a number of animals per hectare of land and is expressed in terms of DSE per ha.

The main aim, when determining a stocking rate, is to achieve the best possible production per hectare and maintain good production per animal, while maintaining a good level of ground cover to protect the soil from wind and water erosion.

Stocking rates vary from farm to farm and district to district and will also vary from year to year depending on particular weather conditions, seasons and management.

When calculating a stocking rate the following factors should be considered:

- the quantity and quality of pasture available
- pasture growth rate
- production targets for the animals
- the classes of animals grazing the pasture.

Feed budgets can be used to determine stocking rates and grazing days. Stocking rates should be set to optimise pasture utilisation.
To determine a feed budget we depend on knowing:

1. Demand - what the animal needs
2. Supply - what is available to the animal

The demand will depend on the class of animal and the production target (maintenance, liveweight gain). The supply is feed currently available and the expected or predicted growth rates.

The tables below set out average requirements for different classes of animals.

*The daily energy requirement of a 50kg sheep and a 500kg cow and how this can be achieved on pastures of different digestibility.*

<table>
<thead>
<tr>
<th>Class of Animal</th>
<th>FOO @ 80% DDM* to meet this intake</th>
<th>FOO @ 60% DDM* to meet this intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry adult sheep</td>
<td>800 kg/ha</td>
<td>1500 kg/ha</td>
</tr>
<tr>
<td>Late pregnant ewe</td>
<td>1000 kg/ha</td>
<td>2000 kg/ha</td>
</tr>
<tr>
<td>Lambing ewe</td>
<td>1400 kg/ha</td>
<td>3000 kg/ha</td>
</tr>
<tr>
<td>Early lactating ewe</td>
<td>1800 kg/ha</td>
<td>Not able</td>
</tr>
<tr>
<td>Dry cow</td>
<td>800 - 1200 kg/ha</td>
<td>2000 - 2400 kg/ha</td>
</tr>
<tr>
<td>Pregnant (7 month) cow</td>
<td>1200 - 1400 kg/ha</td>
<td>3000 - 3400 kg/ha</td>
</tr>
<tr>
<td>Calving cow</td>
<td>2000 - 2200 kg/ha</td>
<td>Not able</td>
</tr>
<tr>
<td>Lactating cow (calf 2 mths)</td>
<td>2200 - 2600 kg/ha</td>
<td>Not able</td>
</tr>
</tbody>
</table>

Maximum daily intake for a 50kg sheep is about 1500g.

Maximum daily intake for a 500kg cow is about 12.5kg (non-lactating).

N.B. Assume pasture type is a fairly upright pasture. There would be a higher FOO requirement for a pasture of greater density with a tight thatch close to the ground.

*DDM = % digestibility of dry matter.

*Source: adapted from Prograze Segment 2, Page 6.*
Feed budgeting is like any other form of budgeting - a goal must be set and all of the factors that influence reaching that goal must be considered and planned for.

Feed budgeting starts with animal targets or pasture growth targets. The factors that have to be taken into consideration are current feed on offer, potential pasture growth (PGR) over a specified period, livestock feed requirements and number of livestock.

Example – Farmer Gilbert has 150 ewes ready to lamb. He plans to lamb into a 20ha paddock. The ewes and lambs will be in the paddock for 42 days. The ewes will have a 2.3 kilogram per head per day (kg/hd/day) green dry matter (DM) requirement.

The first step is to determine the pasture production. It is recommended that 1500kg green DM/ha is present in the paddock as a base figure (this allows enough plants in the pasture to provide enough growth for lambing ewe requirements, while maintaining ground cover). Pasture growth rate is 20kg DM/ha/day.

<table>
<thead>
<tr>
<th>Pasture Available</th>
<th>Present pasture</th>
<th>1800kg green DM/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minus minimum pasture required</td>
<td>1500kg “ “</td>
</tr>
<tr>
<td></td>
<td></td>
<td>300kg green DM/ha</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pasture Growth</th>
<th>Number of days pasture required</th>
<th>42 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multiplied by pasture growth rate</td>
<td>20 kg green DM/ha/day</td>
</tr>
<tr>
<td></td>
<td></td>
<td>840 kg green DM/ha</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Available Pasture</th>
<th>Present available pasture</th>
<th>300 kg green DM/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plus pasture growth</td>
<td>840 kg “ “</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1140 kg “ “</td>
</tr>
<tr>
<td></td>
<td>Minus 30% wastage due to fouling and trampling</td>
<td>342 kg “ “</td>
</tr>
<tr>
<td></td>
<td></td>
<td>798 kg green DM/ha</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feed required</th>
<th>Daily feed required</th>
<th>2.3 kg green DM/hd/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Multiplied by number of days</td>
<td>42 days</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96.6 kg green DM/hd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stocking rate required</th>
<th>Total available pasture</th>
<th>798 kg green DM/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Divided by feed required</td>
<td>96.6 kg green DM/hd</td>
</tr>
<tr>
<td></td>
<td>Stocking rate</td>
<td>8.26 hd/ha</td>
</tr>
</tbody>
</table>

Therefore, in the 20 ha paddock, 166 ewes can feed for 42 days, as he only has 150 ewes, they can safely lamb into the 20 ha paddock.
The supplementary feeds given to animals usually contain high levels of protein or energy. Some supplements are given while there is enough pasture bulk to meet animal intake requirements but protein, vitamins, minerals or energy are deficient in their diet. Feeding supplements can be expensive. It is important to make sure they contain the required energy value as well as protein, vitamin or mineral level, if these are also required.

It is important that the value of supplementary feeds are known when they are offered to stock. To make sure that value for money is being obtained for energy being fed to animals, the cost of energy (megajoules of metabolizable energy per kg of dry matter) can be calculated.

**Example:** If a supplementary feed costs $130/tonne and each kilogram of feed contains 12 megajoules of metabolizable energy per kg, what is the cost of each megajoule of energy?

\[
\frac{130/\text{tonne}}{12 \text{ (megajoules of energy/kg)}} = \frac{130}{12} \text{ cents/megajoule energy}
\]

**Nutritional Values of Some Supplementary Feeds**

<table>
<thead>
<tr>
<th>Feed</th>
<th>Energy (ME in MJ/kg)*</th>
<th>Protein (%CP)**</th>
<th>Fibre (% ADF)***</th>
<th>Digestibility (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat grain</td>
<td>12.0</td>
<td>10.5</td>
<td>4.0</td>
<td>85</td>
</tr>
<tr>
<td>Barley grain</td>
<td>12.0</td>
<td>10.0</td>
<td>6.5</td>
<td>85</td>
</tr>
<tr>
<td>Oat grain</td>
<td>10.0</td>
<td>7.0 - 14.0</td>
<td>15.0</td>
<td>75</td>
</tr>
<tr>
<td>Lupin seed</td>
<td>12.5</td>
<td>30.0</td>
<td>17.0</td>
<td>85</td>
</tr>
<tr>
<td>Cereal hay</td>
<td>6.0 - 9.8</td>
<td>7.0</td>
<td>32.0</td>
<td>40 - 65</td>
</tr>
<tr>
<td>Cereal straw</td>
<td>5.3 - 7.5</td>
<td>4.0</td>
<td>58.0</td>
<td>35 - 50</td>
</tr>
<tr>
<td>Dry paddock feed</td>
<td>5.3 - 8.3</td>
<td>4.0 - 8.0</td>
<td>40.0 - 60.0</td>
<td>35 - 55</td>
</tr>
</tbody>
</table>

*ME: metabolizable energy

**CP: crude protein = nitrogen content x 6.25

***ADF: acid detergent fibre, a measure of the cellulose and lignin fractions of fibre

*Table sourced from Farm note No. 65/91*
**Energy Requirements of Animals**

<table>
<thead>
<tr>
<th>Class of Sheep</th>
<th>Energy Required MJ/day</th>
<th>Class of Cow</th>
<th>Energy Required MJ/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry adult</td>
<td>6.8</td>
<td>Dry cow</td>
<td>53</td>
</tr>
<tr>
<td>Late pregnant</td>
<td>9</td>
<td>(7 month)</td>
<td>65</td>
</tr>
<tr>
<td>Lambing</td>
<td>11</td>
<td>Calving</td>
<td>75</td>
</tr>
<tr>
<td>Early lactation</td>
<td>14.2</td>
<td>Lactation (calf 2 mths)</td>
<td>85</td>
</tr>
</tbody>
</table>

**Methods of Supplementary Feeding**

Supplementary feeds should be introduced to stock slowly to allow the population of microorganisms in the rumen to change so that the feed will be properly digested.

Grain poisoning can occur if grain is introduced too quickly to the animals - this can lead to death. To allow time to introduce the supplementary feeds to the animals, feeding at low rates should be started at least two to three weeks before commencing full supplementary feeding program.

There are three common methods for distributing supplementary feeds to animals:

Trailing grain on the ground - this is where the grain is trailed out in a line across a paddock from the back of a vehicle. It is best to use grain or pellets that are large and easy for the animals to pick up. Alternatively the grain can be ‘spun out’ so that the stock need to cover the paddock to pick up the grain.

Placing feed in troughs - this is useful for small or cracked grains and also if nutritional additives are mixed with the grains.

Self-feeders - these are used when the stock get continuous access (ad lib) to a supplement. They can be used for grain or other feed mixes and are useful because they greatly reduce the amount of feed that is wasted. Hay (with the baling twine removed) is frequently placed in self-feeders as less is wasted.
Feedlotting must be carefully planned as the animals are only able to eat the food given to them and there must be a constant supply of fresh water. The feed is carefully formulated, usually to promote high levels of weight gain. It is an expensive form of production, so farmers should carefully consider costs involved and likely returns when planning to feedlot animals. As animals do not need to continually graze and walk to water much less ‘movement energy’ is used and this contributes to higher liveweight gains.

There are quite a few situations where feedlotting occurs:

Over summer/autumn, the quality and quantity of feed in the paddocks is often quite poor, so sheep are removed to a smaller area where their feed intake can be monitored (to ensure continued production) and to reduce the risk of wind erosion on paddocks where ground cover is scarce.

Feedlotting animals for the first few weeks after the autumn break allows pastures to establish before grazing commences. This practice is often referred to as deferred grazing.

Unfinished prime lambs can be carried over summer so that they may be sold in autumn when prices are higher.

To finish (or fatten) wethers prior to export. It also helps to wean them onto a special diet before they are shipped.

Cattle can be lot fed so that they are finished ‘out of season’ and reach the market at a time when prices are higher.

Care should be taken when selecting a feedlot site. Consideration should be given to:

a) Soil type should be stable to prevent erosion by wind or water.

b) Availability of shelter for the animals from the wind and sun.

c) Topography to ensure that drainage is adequate.

d) Location of water and feed supply for ease of access to the animals.

Pasture grows much faster in spring than the animals can eat it. This means that there is a surplus of feed. Work by Agriculture Western Australia has shown that most farmers only use 50 to 60% of the pasture they produce. Farmers can change their grazing strategies to better utilize or ‘conserve’ this pasture so that it may be used at a time when there may be feed shortages or pastures are low in quality (eg. autumn).

Conserving pasture means to cut pasture and store it for later use. There are two main methods for pasture conservation – hay and silage.

Hay

Hay is made by drying out plant material. The first step in making hay is to mow (or cut) the plants. It is best to mow the pasture when the dominant grass is in early head emergence. The older the plants when mown the lower the nutrient value and digestibility of the hay.

The mown pasture is often windrowed and then left to dry. While drying, the windrows can be raked, to turn the plant material and allowing air to circulate so drying is more even.

When the moisture content of the plant material is less than 20% it can be baled. To preserve the quality of the hay the bales should be stored under cover to prevent exposure to the weather.

Silage

Silage is made by the fermentation of moist plant material by anaerobic micro–organisms.

The pasture material should be cut just prior to the grasses flowering. The cut plant material should be left to wilt until it reaches the required moisture content of 65 – 70% (this can take up to 48 hours).

The wilted plant material must then be stored in an anaerobic environment. There are several ways to store silage, with the most common being pit silage and round bale silage. When filling a pit it is important that it is done quickly and the plant material is compacted to exclude as much air as possible. The pit should be covered with waterproof material and sealed to prevent any air entering the silage. This is the best way to store silage for the long term as a reserve for a very poor season.

For round bale silage the cut plant material is baled in a similar method to that for hay. The bales should be covered with a waterproof material, such as individual polythene bags or silowrap, on the same day that the silage is baled. The plastic material breaks down relatively quickly and develops holes. When this happens the silage spoils and is not suitable to be fed to animals. Round bale silage is best fed in the autumn after making it.

A third method being tried by some farmers and assessed by Agriculture Western Australia is haylage. This involves mowing pasture with an orbital mower leaving the pasture in windrows with a self thatching top layer due to the mower action. This preserves good quality feed underneath and can be fed up to three months later simply by putting stock into the paddock.

Hay freezing and pasture topping may be other options.

More information can be found in FarmNote 98/99 “Fodder Conservation” and Woolpro Reference Manual segment 4 “Fodder Conservation”.
Grazing Strategies

There are four common methods of grazing pastures:

a) Set stocking - the carrying capacity of a paddock is determined and that number of animals is placed on the paddock for a long period of time (in some cases for more than one year). The animals continuously graze the pasture selectively removing more palatable species from the pasture. This allows less preferred plant species to then dominate. In this system animals gain weight in spring and lose weight when the feed dries off in summer and autumn. The main advantage to this system is the low labour requirement. It is not an efficient system in the agricultural areas of Western Australia.

b) A variation on this is continuous grazing. The pasture is grazed continuously but the stocking rate in the paddock is adjusted from time to time (by removing or adding more stock) to match the pasture growth rate fluctuations.

c) Rotational grazing - animals are placed on a paddock at an increased stocking density (compared to set stocking) for a short period of time before being moved to a new paddock. This results in higher production and more even utilisation of the pasture and also allows the pasture time to re-grow before being grazed again. It is a more labour intensive method of grazing and requires the use of pasture and livestock assessment. Strip grazing is a variant of this where grazing is confined to small areas of the one paddock and rotated through it.

d) Intensive spring grazing - used most commonly in southern WA. Stocking densities are increased on some paddocks in spring to match pasture production with pasture consumption. This makes other paddocks on the farm available for feed conservation or to crop. A set level of FOO is determined and the pasture is grazed to this level, which requires regular monitoring. An advantage of this system is that it can increase legume composition of the pasture, control problem grasses and may also help to control redlegged earthmites and other pasture pests for the next germination.

Refer also to “Tactics for different autumns” and “Tactics for different winters” in the Woolpro Reference Manual Segments 2 and 3.

Planning movement of stock

With the goal of achieving maximum production from animals, the main limitation is pasture production. When planning grazing strategy the farmer should aim for optimum pasture utilisation.

It is good practice for farmers to plan the use of the paddocks in advance. This involves assigning a use to each paddock for each month of the year taking into consideration the fluctuations in pasture production and feed requirements of animals.

For more detailed information refer to Prograze Manual Segment 7, “Grazing Management Options.”
It is important to be able to identify the insect pests present in the pasture so that the best method of control can be used.

Insect pests can feed on the leaves, stems, roots and sap of pasture plants. This has the potential to reduce the amount of feed available to animals and also the amount of seed set.

The most common insect pests in pastures are the redlegged earth mite, blue oat mite, lucerne flea and aphids.

Redlegged earth mites are only the size of a pinhead and have black bodies with red legs. They selectively feed on legumes by feeding on the sap of cells on the surface of leaves. Affected leaves look a silvery colour.

Mites lay eggs in the soil that are dormant over winter. They have a similar feeding habit to redlegged earth mites and so also results in silvering of the leaves. They feed on legumes and grasses.

Lucerne fleas are about 2 to 4 mm in size and yellow or green in colour. They lay eggs into clay soils that remain dormant over summer and hatch in autumn. Several more generations can be bred over the winter-spring seasons. They eat from the underside of the leaf leaving a clear layer or ‘window’ in the leaf.

Bluegreen aphids can be up to 3mm in size and are a blue-green colour. All bluegreen aphids are females so reproduction does not require mating with largest populations often occurring during autumn and winter. They favour legumes when feeding. Bluegreen aphids feed by sucking sap from plants. Damage to the plants can be seen as misshapen leaves, yellowed leaves, curled leaves and stunted plant growth.

For further information about collecting insects refer to Farmnote 22/84 “Collection and preservation of insects”.

Useful internet sites:
www.agric.wa.gov.au:7000/ento/pestweb
www.ent.iastate.edu
It is important that animals always have access to clean water. This requires at least one watering point in each paddock. Watering points are generally troughs or dams.

Water with a high salt content will be undrinkable by livestock. The safe upper salinity limit's of water for animal use are:

- **Lactating cows**: 3.03g salt/L water
- **Pigs**: 3.85g salt/L water
- **Horses**: 5.50g salt/L water
- **Lambs, weaners, dry dairy cattle, breeding ewes**: 6.05g salt/L water
- **Beef cattle**: 8.53g salt/L water
- **Adult sheep**: 9.08g salt - 12.10g salt/L water

Troughs can have water pumped to them from dams, rivers or rainwater tanks. Most troughs have a float valve which automatically refills the trough once the water level has dropped.

Dams collect rainwater and runoff from the paddocks above them therefore the water level in dams is seasonal. When levels get low, the dam banks tend to be quite muddy so there can be the danger of animals getting bogged when they go to drink. Algae, which can be toxic, can also be a problem during the warmer months. Farmers should keep a check on dams as water levels drop.

When heavy summer/autumn rains occur large amounts of dry plant residue and faecal material, along with soil, can be washed into dams. This can lead to dams silting up and also chemical contamination of the water.
Land is a very complicated system where many factors (soil, water, plants and animals) interact and depend on each other for survival. The introduction of hard hoofed animals and cultivation of the land has led to an imbalance of these factors and the degradation of some agricultural areas. Problems that have been identified include erosion, compaction and salinity.

Erosion is the removal of soil, mainly by wind (wind erosion) and water (water erosion). The soil becomes exposed when pastures are too sparse due to animals overgrazing or reduced plant growth. The soil then has nothing to anchor it and can easily be removed. Erosion is more severe on sloping ground as the water is able to travel more quickly and collect more soil minerals as it passes over the soil.

Soil compaction occurs when machinery is driven across land and also by the action of hard hoofed animals walking. As the machinery passes over the soil, the weight of it pushes down on the soil breaking soil peds into finer particles and reducing pore space. In a similar way hard hoofed animals exert pressure as they walk pushing down on the soil immediately below the hoofs and closing the soil pores. Once the soil pores have been filled or compacted there is no longer a route for the water to enter the soil and it is more difficult for plants to grow roots into the soil.

Salinity occurs when the ground water rises to within a couple of metres of the ground surface. It can then reach the surface by capillary action in the soil. The water, which contains salts, then evaporates leaving salts on the ground surface and in the surface layers of the soil. Deep rooting native plants were able to keep the water level at least a couple of metres below the ground surface. ‘Clearing’ of these to establish farming land has allowed the water level to rise. As the salt accumulates at the soil surface plants gradually die.

These problems have only really been identified in the last 20 years. Research scientists and farmers are working with Landcare and other government agencies to find ways to solve these problems in the long term. Solutions such as planting trees to lower the ground water, planting pasture species and crops that are deep rooted and salt tolerant, ensuring that the ground is always covered with plant material to prevent erosion and reducing cultivation are some of the solutions that have been implemented by many farmers.

Landcare District Committees are made up of individual Landcare Catchment Groups. It is important that the Catchment groups work together with the District Committees to have access to the most recent research results and also experts in specific fields as required to help develop plans to overcome the problems that have been discussed. The Catchment groups should also be aware of the work being done by other local Catchment groups so that they can work together on issues that are common to them.
The texture of soil reflects the size distribution of mineral particles finer than 2mm. If it is gravelly, remove the gravel by sieving.

1. Take a sample of soil that will sit comfortably in the palm of your hand from the layer of soil to be textured.

2. Form a bolus (ball) of soil by moistening the sample with water and kneading it. Knead the soil for 1-2 minutes while adding more water or soil until it just fails to stick to the fingers. The soil is now reading for shearing (ribboning). Note how the bolus feels when kneading it.

3. Press out the soil between the thumb and forefinger to form a ribbon. The ribbon should be 2 - 3mm thick.

The behaviour of the bolus and of the ribbon determines the field texture. Do not decide texture solely on the length of the ribbon.

<table>
<thead>
<tr>
<th>TEXTURE GROUP</th>
<th>SUBGROUP</th>
<th>BEHAVIOUR OF BOLUS AND RIBBON</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLAY</td>
<td>All Clays</td>
<td>Plastic bolus like putty, smooth to touch, becomes stiffer as clay increases, forms ribbon of 50 - 75mm or more.</td>
</tr>
<tr>
<td>LOAM</td>
<td>Clay loam</td>
<td>Coherent plastic bolus, smooth to manipulate, forms ribbon of 40-50mm.</td>
</tr>
<tr>
<td></td>
<td>Sandy clay</td>
<td>Coherent bolus, feels sandy, forms ribbon of 25 - 40mm.</td>
</tr>
<tr>
<td></td>
<td>Loam</td>
<td>Coherent bolus, feels smooth and spongy, forms ribbon of about 25mm.</td>
</tr>
<tr>
<td></td>
<td>Sany Loam</td>
<td>Weakly coherent bolus, feels sandy, ribbon of 15 - 25mm. Sand grains may be visible.</td>
</tr>
<tr>
<td>SAND</td>
<td>Clayey sand</td>
<td>Clay stain on fingers, very slightly coherent bolus, ribbon of 5 - 15mm</td>
</tr>
<tr>
<td></td>
<td>Loamy sand</td>
<td>Very slightly coherent bolus, dark staining of fingers, minimal ribbon of about 5mm.</td>
</tr>
<tr>
<td></td>
<td>Sand</td>
<td>Cannot form a bolus, non-coherent.</td>
</tr>
</tbody>
</table>
1. Take samples of soil from two different locations, carefully digging the soil so as not to break up soil peds.

2. Choose one container of soil. Place it in a 20mm sieve and gently shake the soil through so that it lands on a piece of paper. The aggregates left in the sieve are called clods. Weigh these clods and write the weight in the table below.

3. Place the soil collected on the piece of paper in a 5mm sieve and gently shake the soil through onto a piece of paper. The aggregates left behind on the sieve are called crumbs. Weigh these crumbs and write the weight down in the table below.

4. Place the soil collected on the piece of paper in a 2mm sieve and gently shake it through onto a piece of paper. Granules are left in the sieve. Weigh these granules and enter the weight in the table below.

5. The soil collected on the piece of paper should be single grains of soil. Weigh these and enter the results in the table.

6. Repeat steps 2 to 5 for the second soil sample.

<table>
<thead>
<tr>
<th>Aggregate Size</th>
<th>Description</th>
<th>SAMPLE 1</th>
<th>SAMPLE 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;20mm</td>
<td>clod</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 - 20mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 - 5mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Were there any differences between the two samples, if so what were they?

What do you think was the reason(s) for these differences?
Texture of soil is used as a guide to the proportions of sand, silt and clay in the soil. It can easily and roughly be determined by working a palmful of moistened soil into a ball, then pressing it out between the thumb and forefinger.

1. Take a handful of soil and remove any gravel, stones, leaves and twigs.

2. Adding a little water at a time, knead the soil in your palm to make a ball about 4cm in diameter. Stop adding water as soon as the ball starts sticking to your hand and knead for another 30 seconds. It is almost impossible to mould a ball with very fine sandy soil and much easier with a clay soil.

3. Press the ball between your thumb and forefinger to form a ribbon. The longer the ribbon, the more clay in your soil. A gritty feel indicates sand (you can hear the sand grinding if you hold the ball to your ear). A silky feel indicates silt and a plastic, sticky feel indicates clay.

4. Compare your ribbon length with the Texture Table below.

<table>
<thead>
<tr>
<th>Ball</th>
<th>Ribbon (cm)</th>
<th>Feel</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td>will not form a ball</td>
<td>-</td>
<td>single grains of sand stick to fingers</td>
<td>sand</td>
</tr>
<tr>
<td>ball only just holds together</td>
<td>0.5</td>
<td>gritty</td>
<td>loamy sand</td>
</tr>
<tr>
<td>ball just holds together</td>
<td>0.5-1.3</td>
<td>sticky, sand grains stick to fingers</td>
<td>clayey loam</td>
</tr>
<tr>
<td>ball just holds together</td>
<td>1.3-2</td>
<td>very sandy to touch, visible sand grains</td>
<td>sandy loam</td>
</tr>
<tr>
<td>ball holds together</td>
<td>1.3-2</td>
<td>fine sand can be felt</td>
<td>sandy loam</td>
</tr>
<tr>
<td>ball holds together strongly</td>
<td>2.2.5</td>
<td>sandy to touch, sand grains visible</td>
<td>light, sandy loam</td>
</tr>
<tr>
<td>ball holds together</td>
<td>2.5</td>
<td>spongy, smooth but not gritty or silky</td>
<td>loam</td>
</tr>
<tr>
<td>ball holds together</td>
<td>2.5</td>
<td>slightly spongy, sand can be felt</td>
<td>fine loam sandy loam</td>
</tr>
<tr>
<td>ball holds together</td>
<td>2.5</td>
<td>very smooth to silky</td>
<td>silt loam</td>
</tr>
<tr>
<td>ball holds together strongly</td>
<td>2.5-3.8</td>
<td>sandy to touch, sand grains visible</td>
<td>medium sandy clay loam</td>
</tr>
<tr>
<td>ball holds together</td>
<td>3.8-5</td>
<td>plastic, smooth to manipulate</td>
<td>clay loam</td>
</tr>
<tr>
<td>ball holds together strongly</td>
<td>7.5</td>
<td>plastic, smooth, handles like plasticine and can be moulded into rods</td>
<td>clay</td>
</tr>
</tbody>
</table>

What was the texture of your sample?
Interpreting a Soil Test

Recommendations from soil tests vary depending on what is to be grown in the soil, as some plants are more tolerant to acidic soils or alkaline soils and the cost of applying fertilizer for the returns it will produce. The following activity is based on a soil used for pastures, the recommendations in this activity may not apply to every district.

**pH** - this should be in the range 5.0 to 7.0, when the pH is calculated using a CaCl2 solution. If it is below this and Ca, Mg, Al and Na values are adequate no action needs to be taken. Otherwise lime can be added to the soil to raise the pH.

**Nitrogen** - 10 - 15mg/kg of nitrogen is sufficient in pastures as the legumes are should be contributing to the nitrogen in the soil.

**Sulfur** - less than 5mg/kg of sulfur is low and a fertiliser containing sulfur should be applied.

**Phosphorus** - less than 35mg/kg of phosphorus is low and a fertiliser containing phosphorous should be applied.

**Potassium** - this is measured as chemical charges in a solution made from the soil. If this value is less than 80mg/kg then fertiliser containing potassium should be considered.

**Aluminium** - this is measured as a percentage of the ions present in the soil water, this changes with the pH of the soil. If the value is 5% or more lime should be added to the soil to increase the pH.

**Soil Test Results**

Complete the following table using the information above.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Soil Analysis</th>
<th>Nutrient Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH (1:5 water)</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>20 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>4 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Phosphorus</td>
<td>10 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>100mg/kg</td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>0.05 %</td>
<td></td>
</tr>
</tbody>
</table>

On a separate sheet of paper:
Write a report explaining the results and your recommendations to the farmer.
Select a paddock to examine.

Randomly throw the quadrat supplied with the Woolpro kit on the pasture in the selected paddock.

Identify the grasses, legumes and weeds present in the quadrat and list them in the attached table.

Estimate the percentage of grass, legume and weeds in the quadrat and enter this information in the table also.

Repeat steps two to four nine more times in different parts of the paddock.

Using the information collected estimate the percentage of grass and legume over the entire paddock. This can be done by calculating the average percentage of grass and legume for each of the ten quadrats.

(Record your information in the table provided on the following page.)

Questions (answers on a separate sheet of paper)

1. What stage of growth were the grasses at? How can you determine this?

2. Does the pasture provide enough nutrition for the animals grazing it?

3. Is there a good mix of grass and legumes? How did you make this decision?
<table>
<thead>
<tr>
<th>Quadrat No.</th>
<th>Grasses Present</th>
<th>% Grass</th>
<th>Legumes Present</th>
<th>% Legumes</th>
<th>Weeds Present</th>
<th>% Weeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
For this activity you will collect and preserve 15 plant specimens. These will include at least five grass species, four legume species and two weed species.

Collecting Specimens

- When collecting the plants they can be pulled up by the roots or broken off further up the stem.
- To make identification of the plant easier it is best to choose plants that have flowers, and make sure that some leaves are still attached to the specimens you collect.
- It is a good idea to collect more than one of each species so that the best one can be used for your herbarium.
- Remove all soil and dirt from the specimens.

When collecting the plants make sure that you write down all the information you will need for the label.

Drying Specimens

Place each plant between sheets of newspaper (make sure you keep the information needed for the label with the plant) and put sheets of corrugated cardboard between the sheets of newspaper. Place these on a flat surface with a heavy flat weight (e.g. large books) on top. It takes about two weeks for most plants to dry properly.

Mounting Specimens

- You will need heavy A4 paper or cardboard cut to the size of A4 paper.
- Place the specimen on the sheet leaving space in the bottom right hand corner for the label. The specimen can be cut or bent into a V or W shape to fit onto the sheet.
- Attach the specimen to the sheets using thin packing tape or clear glue (do not use masking tape or sticky tape).
- Glue the completed label onto the bottom right hand corner of the sheet.

Labels
Example:

<table>
<thead>
<tr>
<th>Family</th>
<th>Poaceae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botanical Name</td>
<td>Pennisetum clandestinum</td>
</tr>
<tr>
<td>Common Name</td>
<td>Kikuyu</td>
</tr>
<tr>
<td>Collected by</td>
<td>Don Burke</td>
</tr>
<tr>
<td>Location</td>
<td>Williams, WA</td>
</tr>
<tr>
<td>Date</td>
<td>February 5, 2000</td>
</tr>
</tbody>
</table>

[Note that the botanical name is underlined]

When identifying plants using books, try to use the most recent books you can find because some plant families and/or botanical names might have changed in the past few years.
<table>
<thead>
<tr>
<th>Family</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Collected by</th>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Collected by</th>
<th>Location</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Collect two grass and two legume plants.

Draw each plant following these simple guidelines:

Drawings should be as simple as possible - use clear definite lines, there should be no need for shading.

Drawings should be large enough to clearly show all structures without crowding them.

The upper part of your plant should always be towards the top of the page.

Always give a scale for your drawing.

Identify and label the parts of each plant. The following diagrams may be useful:

**Grass**

- Leaf blade
- Collar
- Sheath
- Node
- Stem

**Legumes**

- Leaflets
- True leaf
- Petiole
- Stern
- Cotyledons

Identify which stage of growth the plant is in using the following diagram:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Quantity: Low</th>
<th>Quality: High</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHASE 1</td>
<td>Slow growth after grazing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase</th>
<th>Quantity: High</th>
<th>Quality: Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHASE 2</td>
<td>Rapid growth due to high leaf area</td>
<td></td>
</tr>
<tr>
<td>PHASE 3</td>
<td>Slow growth due to shading of growth points</td>
<td></td>
</tr>
</tbody>
</table>

Source: Prograize
Farmer Christie has 250 wethers, 4 working rams, 300 dry ewes and 640 ewes with lambs. Using the following table, calculate the DSE requirement for his sheep.

<table>
<thead>
<tr>
<th>Class of Animal</th>
<th>DSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Ewe</td>
<td>1.0</td>
</tr>
<tr>
<td>Wether</td>
<td>1.0</td>
</tr>
<tr>
<td>Ewe &amp; Lamb</td>
<td>2.5</td>
</tr>
<tr>
<td>Weaner/Hogget</td>
<td>0.8</td>
</tr>
<tr>
<td>Working Ram</td>
<td>1.2</td>
</tr>
</tbody>
</table>

250 wethers x ____________ DSE _________ = DSE
4 working rams x ____________ DSE _________ = DSE
300 dry ewes x ____________ DSE _________ = DSE
640 ewes & lambs x ____________ DSE _________ = DSE
Total DSE _________ = DSE

He is looking to buy a new property and has been shown three properties. Given the following DSE/ha for each property calculate it’s total DSE.

<table>
<thead>
<tr>
<th>Property</th>
<th>DSE/ha</th>
<th>No. Hectares</th>
<th>Total DSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverslea</td>
<td>8.0</td>
<td>429</td>
<td></td>
</tr>
<tr>
<td>Woodforde</td>
<td>7.5</td>
<td>332</td>
<td></td>
</tr>
<tr>
<td>Murella</td>
<td>9.5</td>
<td>263</td>
<td></td>
</tr>
</tbody>
</table>

Which property would be most suitable for Farmer Christie’s flock’s feed requirements?

Why?

What other factors should he consider when choosing a property to purchase?
Farmers can feedlot their wethers and steers prior to sending them to market to increase their weight gain or to meet specific market requirements (such as grain fed beef). The form of the feed is important as ruminants require roughage for the micro-organisms in their rumen to function effectively. It is also important that the ration animals are fed is carefully formulated to meet their energy, protein and nutritional requirements (eg. vitamins and minerals).

Research and list the components that should be included in a ration -

- 
- 
- 
- 
- 

What unit is the energy content of feeds measured in?

- 
- 
- 
- 
- 

What is the best form for the feed to be fed to:

a) wethers -

- 
- 
- 

b) steers -

- 
- 
- 

Feedlotting has important animal welfare issues. Research the code of practice and outline any guidelines that are in place.

Farmers often plan the use of paddocks on the farm a year or so in advance. This lets them allow for stock movements when pasture in one paddock is nearing its base FOO and another paddock is at its target FOO to introduce stock.

You will prepare a grazing plan for the school farm. To do this you must consider:

- the stocking rate and how it will change over the year
- the classes of stock on the farm
- the fluctuations in plant growth and FOO over the year
- the paddocks most suitable for lambing, calving and weaning
- the production targets for each class of animal

Use the following plan as a guide:

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ewes</td>
<td></td>
<td>Helfers</td>
<td>Spray topped pasture</td>
</tr>
<tr>
<td>FEB</td>
<td>Ewes</td>
<td>Cows &amp; Calves</td>
<td>Ewes</td>
<td>Ewes</td>
<td></td>
<td></td>
<td></td>
<td>Ewes</td>
</tr>
<tr>
<td>MAR</td>
<td>Rest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Helfers</td>
<td>Paddock sown to pasture</td>
<td></td>
</tr>
<tr>
<td>APR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rest</td>
<td></td>
</tr>
<tr>
<td>MAY</td>
<td>Rest</td>
<td>Cows</td>
<td>Rest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JUN</td>
<td>Rest</td>
<td>Cows</td>
<td>Rest</td>
<td>Ewes high density</td>
<td>Rest</td>
<td>Weaner calves</td>
<td>Rest rotation</td>
<td>Ewes-high</td>
</tr>
<tr>
<td>JUL</td>
<td>Cows &amp; Calves</td>
<td>Ewes &amp; Lambs</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUG</td>
<td>Ewes &amp; Lambs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEP</td>
<td></td>
<td>Cows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OCT</td>
<td>Rest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOV</td>
<td>Weaned lambs</td>
<td>Ewes and calves</td>
<td>Allow to seed</td>
<td>Helfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
45 steers are going to be put into a 9 hectare paddock for 30 days. The steers have a 8.5kg/hd/day green dry matter requirement.

The paddock has a FOO of 2000kg green dry matter per hectare and a growth rate of 35kg green dry matter per hectare. The base level of pasture to be maintained is 1200kg green dry matter per hectare. Will there be enough pasture growth to feed the steers for 30 days?

<table>
<thead>
<tr>
<th>Pasture Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present pasture</td>
</tr>
<tr>
<td>Minus base level of pasture</td>
</tr>
<tr>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pasture Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of days pasture required</td>
</tr>
<tr>
<td>Multiplied by pasture growth rate</td>
</tr>
<tr>
<td>B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Available Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present available pasture (A)</td>
</tr>
<tr>
<td>Plus Pasture Growth (B)</td>
</tr>
<tr>
<td>Minus 30% wastage</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feed Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily feed required</td>
</tr>
<tr>
<td>Multiplied by number of days</td>
</tr>
<tr>
<td>D</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stocking Rate Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total available pasture (C)</td>
</tr>
<tr>
<td>Divided by feed required (D)</td>
</tr>
<tr>
<td>E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Steers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocking rate (E)</td>
</tr>
<tr>
<td>Multiplied by paddock size</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
It is important to be able to accurately estimate the FOO in paddocks. To improve your skills it is a good idea to periodically measure the FOO in paddocks and compare the measurements to your estimate. This way you can work out whether you are over or under estimating the FOO and correct your estimations.

Step 1 - As a class mark out the line that will be followed to make 20 to 25 FOO estimates.

Step 2 - Place the Pasture quadrat at the first site and make an estimate of the FOO. It may be useful to handle the pasture to get a feel for the density of plant growth.

Step 3 - Repeat step 2, following the line marked out in step 1, placing the quadrat at regular intervals and recording your estimates.

Step 4 - When finished lay out up to ten numbered quadrats. Estimate FOO and record this for each one. Cut quadrats at ground level and place in bag labelled with the same number as the quadrat.

Step 5 - Allocate groups different bags containing the cut pasture. Each group then empties the bag and removes any rocks, manure, soil or other material that is not part of the pasture.

Step 6 - If the pasture sample is dirty, wash it in a bucket then spin it in a salad spinner until no more water comes out. Replace in original bag.

Step 7 - Dry in drying oven at 60°C to 80°C until the dry weight is constant. If no drying oven is available then refer to the Woolpro Paddock Manual Appendix ‘Using a microwave oven’.

Step 8 - Multiply the dry weight by 100 to get the FOO value in kg/ha.

This is the Feed On Offer!
Supplementary Feeding Worksheet

List three reasons why farmers give their animals supplementary feed:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

When is supplementary feeding most commonly carried out in your district?

________________________________________________________________________

Why is supplementary feeding carried out at that time?

________________________________________________________________________

Supplementary feed should be introduced slowly to sheep and cattle. Why?

________________________________________________________________________

There are quite a few options when considering which supplementary feeds to use. What are the types of supplementary feeds available to use in your district?

________________________________________________________________________

Choose one type of supplementary feed and find out the nutrients it contains.

Supplementary feed:

________________________________________________________________________

Nutrients in feed:

________________________________________________________________________

Choose one nutrient in the supplementary feed and calculate the cost of that nutrient per kilogram of feed:

Cost of feed per kg = ___________________________ (A)

Grams of nutrient per kg of feed = ________________ (B)

Cost of nutrient = \( \frac{A}{B} \) = ___________________________ ¢/kg feed

Now calculate the cost of energy in that supplementary feed:

Cost of feed per kg = ___________________________ (A)

Megajoules of energy per kg of feed = ________________ (C)

Cost of energy = \( \frac{A}{C} \) = ___________________________ ¢/ kg feed
INSECT ACTIVITY

On a separate piece of paper research and draw the life cycles of:

a) redlegged earth mite

b) blue oat mite

c) lucerne flea

d) blue green aphid

Given the lifecycles of the above pests, when would be the best time to implement control measures for each of them?

a) redlegged earth mite

b) blue oat mite

c) lucerne flea

d) blue green aphid

How do farmers control these pests on-farm?

a) red legged earth mite

b) blue oat mite

c) lucerne aphid

d) blue green aphid

Visit a chemical supplier and determine the best method of control.

Are there any beneficial insects?
INSECT COLLECTION ACTIVITY

Prepare a small specimen jar by pouring a small amount of ethyl acetate into it and screw on the lid to ensure that it is airtight.

Using a butterfly net, pass it through a sward of pasture to collect any insects that might be in the pasture.

Carefully place one insect into each jar and leave for a day to euthanase the insect.

Carefully remove the insect from the jar and arrange its wings as legs as shown in the picture below.

Identify the insect
(this can be done using books or the internet site www.agric.wa.gov.au/7000/ento/pestweb).
Write the scientific and common names of the insect, the date it was collected, where it was collected and your name on a label.

Sourced from Farmnote No. 22/84

Pin the insect through the location shown on the above diagram onto a piece of board.
This Section

Ageing Sheep and Cattle
Sheep and Cattle Breeding Cycles
Reproductive Management of Sheep
Reproductive Management of Cattle
Assessing Wool Quality
Quality Assurance
Marketing

ACTIVITIES
**KEYWORDS**

Foetus – a developing animal in a uterus
Gestation – the period of time between conception and birth
Weaning – the removal of young animals from their mothers, end of the period of feeding on mothers milk
Sheep

The age of a sheep can be determined in two ways.

The first method involves counting the sheep’s incisor teeth. This is not an exact method but it is fairly reliable. The first set of teeth are called ‘lambs teeth’, which are similar to ‘baby teeth’ in humans. These teeth gradually fall out and are replaced by adult teeth. The number of adult teeth gives an indication of the age of the sheep as can be seen in the diagram below. (Remember that sheep only have incisor teeth on their bottom jaw.)

Adapted from Sheep Production Guide Book 1 New South Wales Agriculture Home Study Program

The second is to use ear tags colour coded to years. Farmers who ear tag their sheep according to the year they were born are able to quickly and easily determine the age of their sheep.

There is a set colour for years which is used in the throughout the industry. eg.

- 1996 Purple tag
- 1997 Yellow tag
- 1998 Red tag
- 1999 Blue tag
- 2000 Black tag
- 2001 White tag
- 2002 Orange tag
- 2003 Green tag
- 2004 Begin again with purple

Cattle

The age of cattle can be determined by counting the animal’s teeth, called ‘mouthing’.

Cattle grow teeth in a similar way to that of sheep – they are born with teeth that fall out and are replaced by permanent incisors. The number of permanent incisors gives a rough guide to the age of the animal.
**Sheep**

Sheep are seasonal breeders.

Merino ewes tend to ovulate between January and June as the day length decreases (this is known as a photoperiod response). The breeding season for other sheep breeds varies slightly from the Merino. When sheep are not ‘in season’ they can be stimulated to ovulate using rams or teasers (wethers that have been treated with the hormone testosterone). Ovulation can also be synchronised by treating the ewes with the hormone Flugestone. This is mainly used in artificial insemination programs.

Nutrition is also an important influence on ovulation. If there is not sufficient feed to maintain the ewe then ovulation might not occur at all.

Ewes can be sexually mature from five to six months of age, however they are not usually mated in Australia until they are about eighteen months of age. This allows the ewe to reach an adequate body size.

Gestation in sheep lasts for 150 days or about five months. During this time the nutritional requirements of the ewes increases. Also as the ewe comes up to lambing time she experiences a loss in her natural immunity. This is thought to be due to hormonal changes associated with pregnancy and is known as the Periparturient Relaxation of Resistance. This is particularly important with regard to worms and sometimes a small number of worms in the ewe can build up to high levels close to lambing time. Therefore it is worth checking the level of the worm burden in ewes about a month before lambing using a faecal worm egg count monitor.

Lambs are weaned from ewes at twelve to twenty weeks of age. The ewes are then joined again two to three months later.

**Cattle**

Heifers are sexually mature between 12 and 15 months of age. From their first heat period heifers will then go through the oestrus cycle every 20 –21 days, unless they are pregnant.

Gestation in cattle lasts for 280 days or about nine months. Cows should be in condition 2.5 to 3 at joining and this should be maintained throughout pregnancy. It is recommended that they do not have an increasing plane of nutrition during pregnancy as this can lead to birthing difficulties.

Most cattle producers aim for the cows to have one calf every year. It takes on average 55 days for the cow to have it’s first oestrus cycle after calving. This means that the cows must be joined again, with calves at foot. At this time the cow has a huge energy demand and it’s nutrition must be improved to meet this requirement.

The calves not being sold as vealers are weaned from the cows from 5 months of age. Vealers are sold off their mothers at 8 to 9 months of age.
### Rams

The generally accepted rule is to have 1.5 percent of rams to ewes, which practically translates to two rams per hundred ewes. As there are far fewer rams than ewes it is important to carefully choose the rams that will be used for joining and to ensure they are healthy and fertile before they are put in with the ewes.

Fertility of the ram is governed by the size of his testicles. Each gram of testis can produce a gram of sperm per day, so the larger the testes the greater the sperm production. Sperm production can be reduced if the ram is stressed which can be caused by overheating, disease or poor condition.

Rams should be checked eight weeks before they are to be joined with ewes as it takes this long for the sperm to be produced. Testicles should be palpated to check that they are symmetrical and firm and that there are no lumps, swelling or abnormalities. There should not be any signs of flystrike and the prepuce and penis should be free of disease. The legs, feet and teeth should also be sound. Just prior to joining these checks should be carried out again.

Rams should be supplementary fed (generally with lupins) two to three months prior to joining to increase sperm production and increase their condition score to about 3.5.

It is recommended that rams have no more than three months wool growth at mating to prevent them from overheating.

### Ewes

Ewes should be condition score 3 at joining for maximum reproductive rate and this should be maintained for the period of gestation.

It is important that they do not have a dramatic change in condition while pregnant and that they also do not get too fat as this may lead to problems at lambing. The time of joining should be decided after considering the condition of the pasture and temperature when the ewes would be due to lamb. It is important that there is sufficient green feed just before lambing and for a few weeks after lambing to meet the nutritional requirement of the ewe. The availability of paddocks to meet these requirements should be included in your initial feed budget.

Some farmers introduce teaser rams a couple of weeks before joining. The presence of these teaser rams will stimulate the ewes to ovulate. The ewes should then ovulate approximately every 17 days.

Rams are introduced to the ewes and usually allowed six weeks for joining. This should allow each ewe two opportunities to mate. The mating mobs should be regularly checked to ensure that the rams are actively mating. A longer joining period than this could lead to a drawn out lambing period and cause problems later with managing lambs.

The condition score of the pregnant ewe should be maintained at a minimum of 2.5. Pregnant ewes should be handled as little as possible to minimise their stress. During the last six weeks of pregnancy the feed requirement of the ewe increases and their body weight should increase by 4 to 6 kg (most of this is foetal growth). At this time the foetus is increasing in size and taking up more room within the abdominal cavity of the ewe.
This reduces the room the ewe has to fill with food and thus reduces her appetite. Consequently the quality of feed on offer to the ewe at this time is important.

Pregnant ewes should be placed in the lambing paddock well before they are due to lamb. They should not be disturbed for at least two weeks prior to lambing. The lambing paddock should have good shelter for the ewes and lambs and plenty of feed.

Ewes should ideally have a condition score of 2.5 to 3 at lambing. Once lambing has started a close eye should be kept on the lambing ewes so help can be given to ewes with birthing difficulties.

Lactating ewes have a very high nutritional requirement as milk production has a high energy requirement. The ewe’s appetite also increases greatly after lambing. It is recommended that FOO levels in pastures be maintained at a minimum of 1800 kg DM per hectare.

Lambs are usually weaned from the ewes at 12 to 14 weeks of age. Ewes should have a minimum condition score of 2.5 at this time.

**Weaning lambs**

When weaning lambs they can be split into two mobs—ewe weaners and wethers.

The paddock onto which lambs are weaned must be selected with care. The pasture should include a good proportion of legumes and be short and soft. If the pasture is allowed to grow too long then the quality will decrease and grass seeds can become a problem. Weaners do not like grazing long, rank, tough pastures. The paddock should also have shelter for the weaners and a plentiful supply of clean water.

When supplementary feeding commences with weaners it is good practice to put a small number of older wethers with them. The older sheep ‘teach’ the weaners to eat the grain or other food put out.

Being young, growing animals weaners have increased susceptibility to disease. They typically require a drench when weaned to remove worms that they have picked up. This practise however should be discussed by the farmer with the local veterinarian or farm adviser to ensure that the latest, most effective worm control practices are being used. It is also important that the paddock is not heavily contaminated with worm eggs and larvae deposit’s by the previously grazing sheep. It is a recipe for disaster to wean the lambs back into the lambing paddock as worm contamination in this paddock is usually very high due to the Periparturient Relaxation of Resistance in the ewes around lambing time.

For further info on weaning lambs see Farmnote 39/97.
Artificial Insemination

The use of artificial insemination (AI) has increased markedly over the last ten years.

This has resulted from the development of laparoscopic AI for frozen semen. This is a specialised procedure which requires a veterinarian. The techniques with fresh semen are much simpler, and may be performed readily by sheep breeders. The purpose of AI is to increase the rate of genetic improvement in livestock. It may contribute to this goal in several ways.

- It allows more extensive use of the best available sires, thereby increasing selection pressure and the rate of response to selection. Such benefits will only be obtained if the sires used for AI are genuinely superior to the rest of the flock.

- Younger sires may be used more widely, resulting in faster genetic progress through a reduction in generation intervals.

- Superior sires can be identified more easily through progeny testing.

It is also associated with certain animal health benefits. It may be possible to move semen to or from properties where disease risk or quarantine prevents livestock movement. Sires whose semen is to be sold without restriction must pass strict health tests. It may be preferable to use AI for such sires rather than expose them to the risk of infection during natural mating. The nature and scale of an appropriate AI program and its associated costs and benefits will be different for every breeder. It is advisable to seek expert advice before beginning an AI program.

Embryo Transfer

Embryo transfer involves the collection of a large number of embryos from genetically superior donor females and their transfer into less valuable recipients. The recipient females carry the transferred embryos through to birth. This allows the donor female to produce several crops of embryos for transfer, in addition to giving birth to her progeny naturally. Repeated superovulation and embryo recovery from selected females can increase the number of lambs born per female per year. Embryo transfer allows the intensive selection of females as well as sires, in contrast to artificial insemination, which only allows intensive selection of sires. This potential can be exploited to accelerate the genetic improvement within a flock or to propagate the genes of a valuable breed. Since embryo transfer is more expensive than artificial insemination, the selection of donor females is most important. Breeders who use embryo transfer should keep individual records so that females that have the highest production can be identified accurately.

**Bulls**  
Fertility of the bull is governed by the size of his testicles. Each gram of testis can produce a gram of sperm per day, so the larger the testes the greater the sperm production. Sperm production can be reduced if the bull is stressed which can be caused by overheating, disease or poor condition.

Bulls should be checked three months prior to joining to ensure that they are in good condition. They should have a condition score of at least 2 for joining. If they do not have sufficient condition then supplementary feeding should commence to increase condition. The bull’s feet and legs should be checked to ensure they are sound so that the bull will be able to easily mount the cows. Testicles should be palpated to make sure there are no lumps or abnormalities. The teeth should also be sound as this affects the amount of feed that the bull is able to consume. Just prior to joining these checks should be carried out again. One bull is commonly used to serve between 40 to 50 cows.

**Cows**  
Cows should have a condition score of at least 2.5 at joining and this should be maintained or even improved during gestation.

Heifers at their first mating should weigh at least 270 to 280kg, depending on the breed. If cows are not up to condition they should receive supplementary feeding at least six weeks prior to joining. However, as with ewes, it is important for cows not to get overfat.

Bulls are introduced to the cows and usually allowed about nine weeks for joining. This should allow each cow three opportunities to mate. If cows are in good condition and the bull is working then two thirds of the cows should fall pregnant on the first oestrus cycle. The mating herds should be regularly checked to ensure that the bulls are actively mating.

Pregnant cows should be handled as little as possible to minimise their stress. They should be placed in the calving paddock well before they are due to calve.

The calving paddock should have good shelter for the cows and calves and plenty of feed, but limited access to feed until after calving. Cows should ideally have a condition score of 3 at calving. A close eye should be kept on the calving cows so help can be given to cows with birthing difficulties.

Lactating cows have a very high nutritional requirement as milk production increases energy requirements by 60%. This can be met by placing the cows in a paddock with a high enough FOO (this figure varies depending on breed and age of cow) or by providing the cows with supplementary feed.

Calves can be weaned from the cows from 5 months of age. Cows should have a minimum condition score of 2.5 at this time.

**Weaning Calves**  
Weaning is the removal of calves from cows. At this time the weaners may be split into two groups – heifers and steers.

The paddock onto which calves are weaned must be selected with care. The pasture should include a good proportion of legumes and be short and soft. If the pasture is allowed to grow too long then the quality will decrease. Weaners do not like grazing long, rank, tough pastures. The paddock should also have a plentiful supply of clean water.

Being young, growing animals weaners have increased susceptibility to disease. They typically require a drench when weaned to remove worms that they have picked up. This practice, however should be discussed by the farmer with the local veterinarian or farm adviser to ensure that the latest, most effective worm control practices are being used.
Farmers producing sheep for wool need to understand how wool is classed so that they can make the correct decision when deciding which sheep to keep in the flock and which sheep to cull.

There are quite a few characteristics of wool that should be considered when determining the quality of wool.

**Colour**
- white wool is highly desirable as it can be dyed a wider range of colours if necessary.

**Fibre diameter**
- this is the thickness of the wool fibre, measured in micrometres (or microns). Generally the smaller the micron the more valuable the fibre because it can be processed to produce a finer yarn which can be used to make light weight fabrics.

**Staple length**
- this is the length of the wool staple (a collection of wool fibres) measured in millimetres. The optimal staple length will depend on the planned end use of the wool.

**Staple strength**
- this is a measure of the force required to break the staple (measured in Newtons per kilotex (a measure of the linear density of the wool)). The more force required to break the staple the stronger (or more sound) the wool. Sound wool is highly desired as it is much easier to process.

**Vegetable matter**
- this is any plant contaminants in the wool such as burrs, twigs, seeds and leaves that must be removed by the processor. The more vegetable matter in the wool the more expensive it is to process, making the wool worth less. It is measured as a percentage of each line of wool.

**Hauter**
- average length of wool fibres in a top (this is the raw material bought by a wool spinner). Most spinners require hauter to be between 65 and 80mm. The longer the hauter the better the spinning and weaving properties of the yarn. It is also known as the prickle or comfort factor of the wool.

All these characteristics of wool are influenced by the environment in which the sheep are run and the genotype (Breeding) of the sheep.

Another important issue emerging in wool quality is that of wool chemical residues. This refers to the amount of chemicals left on the wool fibre when it arrives at the processor. Chemicals that may still be on the wool include organophosphates, synthetic pyrethroids and insect growth regulators that are applied to the wool on sheep to control lice and blowflies.

The amount of chemical on the wool can be reduced by following wool withholding periods that may be included on the labels of chemicals used to control external parasites and also by using integrated pest management (this is explained in the Lice and Jetting section).
Quality assurance is being able to produce a product that meets consumer expectations consistently. The emphasis is placed on the customers requirements rather than just delivering a product from the farm.

On-farm quality assurance is a simple system that farmers put in place that involves documenting procedures that are used to perform each key task on the farm, recording the results of these procedures ensuring that these procedures lead to an end product of guaranteed quality and to correct any procedures that may prevent the product from reaching the desired quality.

There are a number of quality assurance programs in place that farmers can use to ensure that they meet quality assurance expectations. Farmers must be accredited to be able to use these programs.

**Sheep**

The sheep meat (including lambs) quality assurance program is called “Flockcare”. It sets out the standards required for lambs and mutton for slaughter, live sheep sales, exports and sheepskins.

There are 15 elements involved in the Flockcare system. They involve animal welfare, using and storing chemicals, sheep and paddock record keeping, carcase quality, transportation of sheep and farmer training. Once farmers are accredited they are given a producer’s identification number, which they then use on vendor declaration forms so that the animals can be traced back to the source if the need arises.

The advantages of farmers becoming involved in Flockcare include providing a more consistent product, improving flock health and record keeping. Farmers that are accredited can achieve preferred supplier status as those buying the product can be confident that it will meet minimum quality requirements.


An emerging issue in wool quality is that of chemical residues. As wool is one of the few natural fibres, it is being promoted as an environmentally friendly product. To ensure that this image is honest, the Woolmark Company now randomly sample wool sold through the auction system for any chemical residues. Farmers can also have their wool voluntarily tested through the Australian Wool Testing Authority as proof their wool contains no chemical residues. Farmers can meet the requirement of no chemical residues by observing withholding periods and implementing an ‘integrated pest management’ approach (refer to External Parasites in Segment 4 for more detailed information).

There are a couple of wool quality assurance programs running in the industry. These are aligned with major agricultural supply companies, such as Wesfarmers Dalgety (Dalcare) and Elders Limited (Clipcare).

**Cattle**

The beef quality assurance program is called “Cattlecare”. It sets out a code of practice for the minimum quality of beef, taking into account chemical residues, carcase bruising and hide damage.

There are 15 elements of Cattlecare. They involve cattle health and paddock records, chemical storage and use, cattle transportation and record keeping. Accredited farmers receive a producer’s identification number that they must use on vendor declaration forms.

Accredited farms are periodically audited to ensure that the farmers system meets the requirements of Cattlecare.

Farmers need to be aware that penalties may be incurred on products not meeting quality assurance standards and in extreme instances may not be accepted by the markets the producer is targeting.

A successful agricultural business must consider the needs and wants of its target consumers. For example, if the world’s people want to buy lightweight and easy care fashion garments, then the wool producer should try to grow wool that is suitable to be used in the production of such garments.

Within agriculture, it is also important to remember that different products are often competing for the same market. For example, if consumers are looking for meat to eat, they can only eat a certain amount of meat each year and can choose between lamb, beef, chicken, pork, and fish. Given this, it is important for producers to understand what consumers want (e.g., lean meat) and target products to meet market demand.

**Traditional marketing**

In the past, agricultural markets have been lucrative and there has been less need to actively compete for market segments and to differentiate some products from others. This has resulted in farmers tending to produce goods and then offering them to the market when harvested and waiting to see what returns they will get.

The disadvantage of this system is that returns can fluctuate and the profit’s for a season depend highly on market condition during the short period of time when produce is offered for sale. For example, in a wildly fluctuating market, which can be the result of external factors beyond the control of the farmer (e.g., foreign exchange rates, production levels in overseas countries), a farmer selling on one day could receive considerably higher or considerably lower prices than another farmer selling exactly the same product but on a different day.

To overcome these uncertainties, marketing boards were established. These boards combined specific goods produced by farmers and in the process limited the competition between them, with the aim of raising the prices. The boards were most commonly managed by state or federal governments.

The majority of marketing boards controlled the flow of the commodity onto the market with the aim of maintaining the price above a minimum level. This could be done by implementing quotas (e.g., milk quotas), or operating a buffering stock scheme (e.g., wool stockpile). Some marketing boards had the power to acquire all the product that was produced in their area of authority (e.g., Australian Wheat Board controlled the sale of all export wheat).

The marketing boards were also able to collect money from producers in the form of levies to fund research. Another advantage of marketing boards was that they were able to maintain quality and grade standards across the product.

During the 1990s, many of the marketing boards relinquished some of their authority to allow the market place to operate more freely. An example of this was the scrapping of the Reserve Price Scheme for Wool in 1991. The Australian Wool Corporation set the minimum price that they would accept for each wool type. If the price offered was less than the reserve price, the wool was stored by the Wool Corporation for resale at a later time when the reserve price could be met. During the time the scheme was in place, a large stockpile of...
and the existence of this stockpile came to reduce the value of the wool that was being produced. Wool is now sold at market value.

A more recent example is the removal of quotas from the dairy industry in the late 1990’s. The quota system of milk supply controlled the amount of milk produced by dairy farmers, which directly influenced the price of milk and dairy products for consumers. With the removal of the quotas, prices have fallen, which also means that farmers incomes have been reduced.

With increased competition, reduced authority of marketing boards and depressed agricultural markets for Australian products it has become critical that farmers maximise their returns to retain a profitable business. This has led to the exploration of many different marketing methods to help to increase returns and reduce fluctuations in the prices received for marketed goods.

**Branding of products**

Farmers who produce similar products can work together to market their products. The more producers who work together, the more reliable the supply of the product and therefore the greater bargaining power these producers have to sell their product. Groups of farmers who work together like this often give a brand name to their product. This may also be considered as a method of adding value to the product.

An example of this is Q –Lamb. This is an alliance of prime lamb producers in Western Australia, who work in co-operation with a meat processor and a chain of supermarkets. The group have set themselves the target of producing lambs with a fat score of 2 to 3 and weighing between 18 and 24 kg. All farmers involved have agreed to a code of practice to ensure that all lambs are produced in a similar way and that each lamb can be traced back to the farm from where it originated. This ensures that all lamb is quality assured and producers are able to maintain a high standard of lamb cuts for the consumer. The lamb cuts are sold at the supermarket with a Q –Lamb brand, which is easily identified by consumers.

Butterfield Beef is a label under which a group of Western Australian grainfed beef producers sell their beef. The beef must meet quality standards and be produced following a code of practice for it to be marketed under the label. Butterfield Beef guarantees the quality of each piece of beef that is sold.

**Marketing of Wool**

The main characteristic that influences wool price is the fibre diameter which is measured in microns. Other factors that influence price include staple strength, staple length, colour and vegetable matter.

The traditional and most common way that wool is marketed is through the open auction system. The wool producer employs a wool broker to sell the wool in the auction system. The wool broker usually charges a commission on the price received for the wool as payment for their services. The broker organises shipment of a sample of wool to be sent to the auction centre. A catalogue outlining the characteristics of each ‘lot’ of wool is published prior to the auction. During the auction buyers bid for each lot and it is generally sold to the highest bidder.
Alternatively, wool growers can sell their wool by private sale. They negotiate a price for the wool directly with the buyer. The quantity and quality of wool will influence the value and therefore price received for the wool. This method of selling bypasses the wool broker.

More recently, wool growers have been able to forward contract their wool. This involves the wool grower ‘locking in’ a price before the wool is harvested. This price is based on the expected micron of the wool and the price at the time the forward contract is taken out. This effectively means that the wool grower is better able to budget the returns for the wool and is not as exposed to market price variations.

Marketing of Sheep Meat and Beef

There has been a significant change in the way sheep and beef meat has been marketed in the past decade. Many producers have started to move away from the traditional method of selling stock through the local saleyards to selling directly to the abattoir or feedlots.

With the introduction of quality assurance, these new marketing options provide the producer with reliable feedback on feedlot performance and carcase quality. An additional benefit to the producer is reduced selling costs with the removal of agents commissions, and saleyard fees.

To sell livestock in the saleyard the producer must work through an agent. The livestock must be transported to the saleyard where they are drafted into pens of similar types of animal and the livestock are then sold using an auction system.

The most frequently used methods of sale are:

- livestock are sold privately;
- livestock are sold through an agent, and
- at saleyards.

Producers are also developing marketing groups. A number of producers producing the same product work together to market their livestock to feedlots or processors.

These groups generally guarantee that their product will meet certain standards (by using the relevant quality assurance program identified by producers) and a regular supply. This is quite often a marketing advantage as the buyer can plan long term production knowing that there is a reliable supply of livestock.

With the introduction of Meat Standards Australia (MSA) in Western Australia (2000), the consumer is guaranteed the tenderness of a cut of beef. The meat is graded in the abattoir before the carcase is processed and several tests are carried out on the carcase to determine the eating quality of the beef. Once the beef has been graded the producer is then sent a feedback form outlining the grades given to his animals and the reasons for these grades. This feedback allows the producer to identify any problems with his production methods which then provide him with the opportunity to improve.
MSA is an excellent marketing strategy implemented by Meat and Livestock Australia as consumers are more willing to pay premiums for meat that has a guaranteed level of tenderness. This is impacting widely on beef consumption in Western Australia.

The most frequently eaten sheep meat is lamb. However, this has not always been the case. During the early 1990s lamb consumption was extremely low. To combat this Meat and Livestock Australia developed and launched an extremely effective marketing strategy ‘Trim Lamb’. This strategy focussed on the low fat characteristics of lamb and has been instrumental in turning around a declining market. Meat and Livestock Australia is currently looking to introduce a lamb meat tenderness guarantee similar to that used for beef.

Apart from domestic sales, live sheep and cattle exports comprise a large proportion of the market. The sheep and cattle are carefully chosen to meet the market requirements of the destination country. An example of this is Middle Eastern countries who will buy sheep that are not in demand in the domestic market. They will purchase older wethers whereas in Australia we prefer lamb. The sheep and cattle are loaded onto specially designed ships and transported to their destination country.
WOOL QUALITY ACTIVITY

Collect staples of wool from three fleeces.

Examine each staple and complete the table below.

- Colour – how close is the staple to white? Describe the colour.
- Fibre diameter – count how many crimps there are in 1cm of fibres in the staple. As a general guide the more crimps the smaller the fibre diameter.
- Staple strength – holding each end of the staple, pull apart the fibres. Note down how difficult it was to break the fibres.
- Vegetable matter – pick out as much plant material and other contaminants that may be in the staple, estimate what percentage of the staple it is.
- Staple length – measure how long the fibres of wool are (in millimetres).

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<th>Fleece number</th>
<th>Colour</th>
<th>Fibre diameter</th>
<th>Staple strength</th>
<th>Vegetable matter</th>
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Are the results you wrote in the table very reliable? ________________________________

Why/Why not?

______________________________________________________________________________

The characteristics of the wool that you have examined are used to determine which processing system the wool will go through. The two processing systems are worsted and woollen.

Find out the type of wool used by each system and the different steps each system has to process the wool. List and describe these steps on a separate piece of paper.
Beef, lamb, mutton, pork and fish are all competitors within the food market. Do you agree or disagree?

What are the implications of this competition for the producer?

Why do you agree/disagree?

Find advertisements or detail other promotions for two of these commodities and discuss ways in which the marketers try to persuade the consumer to buy each product.

On a separate sheet of paper design an advertisement to be published in a women’s magazine to promote the consumption of lamb.
Sheep meat prices are published each week in the country newspapers and broadcast on the radio.

1. Over a few weeks record the prices received for at least three different classes of sheep at your local selling centre.

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2. Develop a graph showing price for each type over time.

3. Suggest reasons why there are differences in the prices received?

4. Are these differences in prices reflected in the prices of corresponding meat at the butcher? Why? Why not?

5. How does the condition of the sheep affect the price?
### Monitoring Market Prices for Beef

Beef prices are published each week in the country newspapers and broadcast on the radio.

1. Over a few weeks record the prices received for at least three different classes of beef at your local selling centre.

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2. Graph the price for each type over time.

3. Why are there differences in the prices received?

4. Are these differences in prices reflected in the prices of corresponding meat at the butcher?

5. How does the condition of the cattle affect the price?
This Section

- Worms and Worm Control
- Lice and Jetting
- Important Disease of Sheep
- Important Disease of Cattle

ACTIVITIES
HEALTH ISSUES

KEYWORDS

Abscess – gathering of pus in one part of the body
Faeces – solid waste produced by an animal
Immunity – resistance to a disease
Lousicide – chemical administered to animals to control lice
Parasite – animal or plant living from another plant or animal
Scour – diarrhoea
Toxin – poison produced by micro organisms

1. Laparoscopic – Artificial Insemination
2. Footrot
3. Cheesy Gland
Sheep

Worms are the most significant disease problem currently affecting the sheep industry. In WA there are two main groups of worms that affect sheep:

a) The ‘scour worms’ include the black scour worm (Trichostrongylus spp), brown stomach worm (Ostertagia spp), large mouthed bowel worm (Chabertia ovina) and large bowel worm (Oesophagostomum spp). They tend to cause problems during winter and spring and infections can lead to reductions in body and wool growth rates. If the worm burden is high enough it is also possible to see diarrhoea and/or death.

b) Barber’s pole worm (Haemonchus contortus) occurs mainly during the warmer months of the year. This worm sucks blood from the sheep and can cause anaemia (pale mucous membranes), bottle jaw (accumulation of fluid in the tissues below the jaw) and sheep death.

The key to worm control is to break the worm lifecycle.

General worm life cycle
**WORMS AND WORM CONTROL**

Adult worms of each species, are each found in a specific site within the sheep. They reproduce and lay their eggs which then pass out of the sheep’s gut and onto the paddock in the sheep’s faeces. The eggs in the faeces then hatch to release larvae, which move onto the pasture, where they may be eaten by sheep. After ingestion the larvae can develop through further stages to eventually become adult worms within about three weeks.

| Larvae will survive on pasture for long periods when the temperature is cool and the pasture is moist. In winter, larvae may survive upwards of six months. In summer the heat and dryness destroys the eggs and larvae and larvae often will only survive two months. Giving sheep an effective drench (a colloquial term used for the oral administration of an anthelmintic) will only remove the parasites from inside the sheep therefore it is important to give drenches at times when there are fewer parasites surviving on the pasture to re-infect the sheep. In WA this is achieved by using ‘summer drenches’. At this time the hot dry conditions have removed virtually all of the parasites on the pasture. Therefore the sheep do not immediately pick up more worms when they return to grazing after drenching and hence can stay worm-free for many months. |

**Drench resistance**

While summer drenching gives optimum worm control, it can also encourage the development of drench resistance.

The only worms left in the sheep after a summer drench are those that are resistant to the drench given, and the hot, dry conditions mean that very few eggs and larvae survive on the pasture over summer. The eggs produced by the resistant worms in the sheep therefore lead to an increased level of resistance in the worm population in the next season.

To reduce the risk of worsening resistance any drenches used for a summer drench must be greater than 95% effective and, preferably, as close to 100% effective as is possible.

There are several broad spectrum drench groups (active against all of the important worm species) to choose from. These are the

- benzimidazoles (white drenches),
- levamisole (clear drenches),
- combination drenches (a combination of a white and a clear) and
- macrocyclic lactones (“MLs”: ivermectin, abamectin and moxidectin).

There are high levels of resistance to many of these drenches on most farms throughout Western Australia. This means that the drenches are less than 95% effective (often they can be as low as 20 or 30% effective!) and therefore should not be used. Resistance is present for white and clear drenches on almost all farms and on a majority of farms for combination drenches. There are also an increasing number of properties with ‘ML resistance’ in brown stomach worm.
Because resistance is widespread it is essential to check the resistance status (ie measure the effectiveness of every drench that is planned to be used) before embarking on a drenching program. This involves checking worm egg counts after a group of sheep have been drenched with a particular drench. Usually a number of drenches are tested at the same time. These tests should be run under the guidance of a veterinarian or adviser.

Worm control program
An effective worm control program involves more than just drenching.

It should be carefully planned, and integrate carefully timed drenches, management of pastures to minimise contamination with parasite eggs and larvae and regular monitoring of the worm burdens in the stock.

Faecal worm egg counts are the most effective way of checking the burden of adult worms in your sheep. Ten to twelve individual faecal samples should be tested from each mob that needs to be checked. Monitoring can also be used to indicate whether drenching is needed or not, whether drenching has been effective and which drenches are effective.

Quarantine drenches
The final important part of good worm control is making sure new sheep do not bring resistant worms onto the property.

Introduced sheep should be given a quarantine drench before loading or on arrival. The best option for this is a combination of products from three or more anthelmintic groups. The sheep should then be released onto the wormiest pasture available to dilute any remaining resistant worms.

Cattle
Small brown stomach worm (Ostertagia) is the main problem worm in cattle.

This worm plays the same role in cattle as it does in sheep and has the same life cycle, only cattle are substituted for sheep as the host animal.

Worms are controlled in cattle by the use of drenches, however cattle in general need a lot less treatments than sheep. Many farmers do not need to regularly treat their adult cattle but it is worth drenching weaners at least once a year. A local veterinarian or advisor should be consulted to get the latest worm control advice for your cattle.
Lice on Sheep

The sheep body louse (Bovicola ovis) is the most common louse found on sheep. It is a 1.5 to two millimetre long insect that is pale yellow with a darker head. It has mouth parts adapted for biting and feeds on scurf (flaking skin), sweat and skin bacteria.

There are two other species of lice that can be found on sheep: the foot louse (Linognathus pedalis) and the face louse (Linognathus ovillus). Both of these lice feed by sucking blood but are not very common.

Lice spend their entire life cycle on sheep and they spread by moving directly from one infested sheep to another. They can only survive for a short period of time off the sheep and will not reproduce.

Female adult lice start to lay eggs three days after their last moult and lay about two eggs every three days. The eggs are glued to the lower end of the wool fibres by the female when the temperature is between 35 and 40°C. It takes nine to eleven days for the eggs to hatch. It takes 21 days for nymphs to mature.

Sheep lice life cycle

Sourced from Low Residue Control of Lice and Flies (Woolmark Company)

Lice irritate sheep causing them to bite and pull their wool or rub themselves against fences and trees. This can lead to the fleece of the sheep looking matted and/or having a ragged appearance. Lice infestation can reduce wool production and cause wool to become cotted (matted) which increases the losses when wool is being processed.

The best time to treat sheep for lice is straight after shearing, as there is very little wool left on the sheep to protect the lice from the treatment. Traditionally sheep were swum through a plunge dip or placed in a shower dip so that their entire skin surface came in contact with the lousicide.

In the early 1980’s pour-on treatments were introduced. With these the lousicide is applied as a broad band down the centre of the sheep’s back. The chemical then moves across the sheep’s body. The lousicide is not able to kill the eggs so it should have a residual effect to kill any lice that hatch after the time of treatment.
To reduce reliance on chemicals wool growers are encouraged to adopt integrated pest management strategies. Key strategies are:

- **Selective use of chemicals** – this strategy encourages farmers to only treat sheep with a lousicide if lice are detected on their sheep. This has two advantages; it minimises chemical residues on wool and also reduces the risk of lice becoming resistant to the chemical. The recommended time to treat sheep to eradicate lice is off-shears using an effective pour-on treatment or to dip 2-3 weeks after shearing. As wool length increases, the likelihood of eradication decreases and treatments applied later than 6 weeks after shearing should be followed by an eradication treatment after the next shearing.

Resistance of lice to synthetic pyrethroids was first detected on farms in 1990.

- **Improved management** – The primary aim is to prevent introduction of lice by only buying stock from lice-free flocks and by maintaining stock proof boundary fence.

- **Biological control** – at present the removal of wool at shearing is the only form of biological control of lice. Research is currently being carried out looking at the possibility of the use of viruses, bacteria and fungi to control lice on sheep.

Farmnote 12/2000 Wool residue
Farmnote 13/2000 Sheep Lice
FACT SHEET 1/2001

N.B. Integrated Pest Management (IPM) can be applied to all diseases to reduce the reliance on chemical treatments (eg. worms and flies).

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**Flystrike on Sheep**

Flystrike occurs when blowflies (most commonly the ‘green blowfly’ Lucilia cuprina) lay their eggs in moist areas on the sheep and maggots then hatch from the eggs and feed on the damp wool and skin of the sheep.

After three to four days the maggots are large enough to drop off the sheep and pupate in the soil. If temperatures are warm enough (above 15 oC) an adult fly will emerge from the soil about seven or eight days later and the cycle will continue.

There are three main types of flystrike:

a) **body strike** – occurs on the back, withers and side of an animal and is often associated with fleece rot or mycotic dermatitis (dermo) and long periods of wet weather.

b) **breach strike** – occurs in the region of the crutch and tail. It is the most common area to be flystruck, with ewes being more susceptible due to this area becoming wet with urine. Scouring sheep can also accumulate faeces in the area leaving them susceptible to strike.

Mulesing reduces the amount of wool growing around the breech and also reduces wrinkles in this area, allowing the breech to remain drier. Crutching before warm weather (when flies are active) removes stained wool from the area.

c) **pizzle strike** – occurs around the pizzle on male sheep due to urine stained wool being attractive to flies. It is best controlled by ringing (the removal of a ring of wool around the pizzle) while crutching.

To control flystrike on a property, it is best to try to prevent strike using strategic treatments at the times of year when blowfly numbers are highest. This is often achieved by jetting the sheep with a chemical that offers prolonged protection against strike. If sheep do begin to get struck then individual treatments are necessary from a welfare point of view. The wool should be shorn in about a 100mm band around the strike and chemicals can be applied to kill the maggots. Most fly populations are resistant to organophosphates and these chemicals should be avoided.

With the increasing issue of wool chemical residues it is also important to consider non-chemical flystrike control options. These include culling sheep with wool faults and avoiding other conditions (such as scouring) that make sheep attractive to flies.
**Lice on Cattle**

There are three main species of lice that commonly affect cattle in Australia. Two ‘sucking’ lice (*Haematopinus eurysternus* and *Linognathus vituli*) that pierce the skin and suck blood and one biting louse (*Damalinia bovis*) that wanders around the skin of the animal and lives off material on the surface.

The life cycle is the same for all cattle lice. All stages occur on the host (the cattle) and lice will perish within a week or so if they fall off the animals. This is the reason why the only way lice-free cattle can become infested is via close contact with other cattle that are carrying lice.

Lice eggs are laid by the adult female and attached to the cattle’s coat. The eggs hatch within a week or two and the juvenile lice develop through three nymphal stages into new adults. The length of the lifecycle will depend on a variety of factors including ambient temperature but generally takes between 20 and 30 days.

The basic signs and effects of lice are due to the irritation that the parasites cause by biting or sucking. Infested animals will scratch and rub and the coat will become rough. The blood sucking effects of the sucking lice can also lead to anaemia. All of these effects can also be associated with weight loss and ill-thrift and therefore reduced production.

The severity of a burden will depend on factors such as the weather and type of stock infested. Lice numbers tend to increase in autumn and levels peak in late winter or early spring. Nutritional stress of cattle is also important, as if cattle are well-fed and in good condition, it is rare to see large burdens of lice.

To confirm a lice infestation look for the actual lice on the cattle. Adults are between two and four millimetres long and can be dark bluish to reddish-brown in colour. They are commonly found around the eyes, muzzle and the skin of the perineum (the skin around the rectum of the animals).

Lice can be treated using a lousicide as either a pour-on or injectable product from one of several chemical groups. It is also important to remember seasonal influences, as when temperatures cool during the late autumn any eggs on the animals will start to hatch. Therefore if treatment is too early (before the season has ‘cooled off’) there can be further hatching after treatment and the infestation will continue.
**Footrot**

Footrot is caused by the bacteria *Dichelobacter nodosus*. The bacteria is only able to live in soil for a few days but can survive for long periods in the feet of sheep.

The first sign of infection is inflammation of the skin between the claws of the hoof. If the infection spreads it will progress under the horn of the hoof and under –run all of the horn from between the claws, under the foot and up the outside of each claw. Eventually there can be separation of the sole and walls of the hoof and this can fall off leaving only dead tissue and a foul smelling slime. This is extremely painful for the sheep.

Usually more than one foot is affected by footrot and the sheep become lame, lose condition and wool production may be reduced. The infection spreads when susceptible sheep walk on ground that has been contaminated by affected sheep.

Footrot is a notifiable disease in Western Australia. This means that Agriculture Western Australia must be contacted if it is suspected that sheep on a property have footrot. Inspections and, if necessary, an eradication program can be worked out with a stock inspector or veterinary officer.

More detail can be found in Farmnote 6/98, & 7/98 ‘Footrot Eradication in Western Australia’

**Lupinosis**

Lupinosis is caused by sheep grazing a lupin stubble that is infected by the fungus *Phomopsis leptostromis*. The fungus produces a toxin that causes liver damage in the sheep. This leads to loss of appetite, weight loss, jaundice (yellowing of the mucous membranes such as the gums and around the eyes) and nervous signs such as staggering, wandering aimlessly or fit’s and can eventually lead to death.

There are no practical direct treatments for the condition. If lupinosis is suspected then sheep should be removed from the lupin stubble. Also avoid high protein feeds as the damaged livers need time to recover and cannot cope with a high protein diet.

The best prevention is to be aware of the risk of the problem. Stock grazing lupin stubbles following summer rain (which favours the growth of the fungus and may make lupin stalks softer and more palatable) are most at risk so closely monitor stock if conditions are favourable for fungus growth. Regularly check the level of grain in the stubble as sheep will begin to eat more of the stalks as the grain on offer begins to run out and this plant material is higher risk if the fungus develops. Also make sure that there are ample watering points available through the stubble to encourage even grazing (some sheep will not walk more than a few hundred metres from the water and thus tend to eat out patches rather than eat all of the grain on offer).

It is also possible to plant fungus resistant varieties of lupins but even these are not lupinosis proof. Given ideal conditions, the fungus can produce toxin on any variety.

**Cheesy Gland**

Cheesy gland is caused by a bacteria (*Corynebacterium pseudotuberculosis*) that infects the sheep. This infection causes abscesses with cheese –like pus in the lymph glands and sometimes other organs, such as the lungs and liver, of the sheep.

The disease is most often spread at shearing time. When abscesses are cut or burst during shearing the pus can contaminate the shearing equipment and then the bacteria can get spread to the next sheep to be shorn.
The bacteria can survive for up to five months in damp areas out of direct sunlight. Bacteria enter the sheep through broken skin and are carried in the lymph fluids to the lymph glands.

Sheep carcasses with signs of cheesy gland cannot be exported. If the abscesses can be easily removed, then the carcasses can be used for domestic consumption, otherwise the whole carcase will be condemned and removed from human consumption.

Cheesy gland can be prevented by vaccinating against the disease and maintaining hygiene in the shearing shed. If an abscess is burst during shearing the area and equipment should be disinfected to prevent the bacteria in the pus from infecting other sheep.

Clostridial diseases

All clostridial diseases are caused by clostridial bacteria and can cause sudden death in affected animals.

**Blackleg** – sheep pick up inactive bacteria spores while grazing or they can enter the body through wounds. The bacteria enter the bloodstream and eventually become dormant in muscle. An injury, such as a shearing wound, is thought to trigger the disease and it is possible to get death within 48 hours.

A sheep with blackleg, if seen before death, will have a fever, lose its appetite and have swelling and heat of the affected muscle.

**Pulpy kidney** – (also called enterotoxaemia) – the bacteria that causes pulpy kidney is commonly found in the intestines of healthy sheep. Overfeeding on lush pasture or other dietary upsets, such as a sudden change in feed upsets the gut function and the clostridial bacterial can multiply and build up in numbers. The bacteria produces large amounts of toxin which is absorbed from the gut.

Affected lambs often die suddenly (they can die within a couple of hours) or can show signs of scouring and nervous system signs such as throwing their head back, jumping in the air or paddling (laying on their side with their legs moving backwards and forwards). Adult sheep may stagger about, bloat, be unaware of their surroundings and can die within 24 hours.

**Tetanus** – the bacteria that causes tetanus is commonly found in a dormant form in the soil. Sheep become infected when the bacteria enter wounds but symptoms can take from a few days up to a couple of weeks to appear. The toxin produced by the bacteria affects the nervous system with signs including spasms of muscles, locking of the jaw, protrusion of the third eyelid and walking with a stiff gait. The sheep generally die lying down with their head held back and legs out stiffly.

All of the clostridial diseases can be effectively protected against using vaccination. Ewes should get a booster vaccination a couple of weeks prior to lambing to give the newborn lambs some protection through the colostrum. Lambs should then be vaccinated at marking and again four to six weeks later. A booster vaccine is given at twelve monthly intervals from then onwards.

Mycotic dermatitis (also call ‘dermo’ or ‘lumpy wool’)

Dermo is caused by the bacteria *Dermatophilus congolensis*. When the waxy layer of the skin is disrupted then bacteria are able to invade the skin. The infected area exudes a fluid forming a scabby layer that sticks the wool together. The bacteria
is spread by close contact between infected and non-infected sheep under favourable conditions (e.g. yarding wet sheep).

Affected sheep can be treated with antibiotic injections that, if the sheep are kept dry, can lift the scabs in about six to eight weeks. However, this is expensive and it is better to cull affected sheep and avoid conditions that encourage spread through the flock.

Pregnancy toxaemia

Pregnancy toxaemia is associated with disruptions to feed intake and/or stress during the last six to eight weeks of pregnancy. Anything that reduces nutrient intake, such as poor quality feed or diseases such as footrot or foot abscess, can lead to the problem.

During late pregnancy the nutritional demands of the foetus are very high and if the ewe is not eating sufficient food then she will start to break down her fat reserves to meet the energy requirement. One of the by-products of this fat breakdown is ketone bodies and these can be toxic and affect the nervous system if they build up too much in the ewe’s bloodstream.

Signs of pregnancy toxaemia include ewes not eating, standing alone from the rest of the mob, wandering aimlessly and appearing blind. If untreated, the ewe will eventually go down and become comatose. Ewes can die within a couple or few days of showing first signs.

If the signs are recognised early enough it is possible that the ewe can be treated with an energy product, such as glycerine. It is also very important to improve the feed quality and quantity for all of the ewes in the mob to prevent the problem spreading and recurring.

The disease can be prevented by providing the ewes with sufficient feed. Monitor condition scores and keep them in condition score three. Also avoid anything that might stress the ewes and stop them eating (e.g. yarding heavily pregnant ewes).

Scabby Mouth

Scabby mouth (*contagous ecthyma*) is a viral disease that causes small pustules and scabs commonly on the lips and muzzle of the sheep. The virus can survive in the soil for years and infects the sheep through small abrasions or cuts on the lips and around the mouth (e.g. caused by eating thistles or stubble).

The first signs of infection are swelling of the lips and the appearance of small pustules. Scabby mouth lesions can also occur on the eyelids, scrotum, udder, coronet of the foot and under the tail. These pustules then burst and form scabs, then after another week or two the scabs fall off and add to the contamination of the soil.

Affected sheep develop immunity but can still carry the virus, so any new sheep on the property, including lambs, are susceptible to infection. These susceptible sheep can be vaccinated against the infection if necessary and this is strongly recommended for any lambs that will go to live export markets and on properties where this disease is a major problem.

The scabby mouth virus can also infect humans and cause a red sore at the site of infection.
**Bloat**

Bloat occurs when the animals’ diet leads to formation of a stable foam in the rumen. This foam layer sits on top of the rumen fluids and prevents the animal from burping up gas (eructation) produced by fermentation in the rumen. The rumen then expands and compresses the lungs and/or blood supply. It can cause death in animals by asphyxiating them or by cutting off their blood supply.

It is caused by animals eating a pasture that has a high protein content, such as pastures with a high legume content (e.g. lucerne and medics). Bloat can be prevented by administering anti-bloat capsules that contain chemicals to prevent the formation of the stable foam and/or alter the rumen function. Alternatively, stock can be fed hay to reduce their intake of legumes or carefully watch the stock while they are grazing pastures with a high legume content and remove them as soon as any sign of bloat is seen.

**Clostridial Diseases**

Cattle can be affected by clostridial diseases in the same way as sheep. Clostridial diseases that can affect cattle include Pulpy Kidney, Tetanus and Blackleg.

Refer to section on Important Diseases of Sheep for more details.

**Grass Tetany**

Grass tetany is a metabolic disease caused by magnesium deficiency. It causes cattle to have mild muscle spasms and an unsteady gait. In more severe cases cattle die and have froth from their mouth and nose and rubbed ground where their legs have moved violently before they died. Affected animals can also be very aggressive.

Grass tetany is caused by a few factors that can interact:

- grazing pastures with a low level of magnesium, such as actively growing pastures;
- cows that are calving can be at risk as they are utilising their body reserves to produce milk, reducing their blood magnesium level; and
- short periods off feed, such as when cattle are yarded or stressed, may reduce the levels of magnesium in the blood.

The most effective treatment of grass tetany is to inject affected cattle with magnesium, under the guidance of a veterinarian. Prevention of grass tetany can include placing calving cattle on a pasture that has a bulky legume content, supplementing cattle with lucerne hay, placing magnesium blocks in the paddock for the cattle to lick or dosing cattle with magnesium bullets that slowly release magnesium.

*See Farmnote 63/88'*
**Leptospirosis**

There are two species of bacteria that cause leptospirosis – *Leptospirosis pomono* causes abortion and destroys red blood cells and *Leptospirosis hardjo* causes abortion and loss of milk production. The bacteria can be carried by many animals including wild pigs, making eradication of this disease difficult.

The bacteria are located in the kidney of infected animals and spread in the urine. Bacteria can be discharged from infected animals for up to twelve months and live in warm moist soil for up to six months. Humans can contract the disease from infected cattle through contact with urine, uterine discharges or milk with bacteria entering through cuts, sores or mucous membranes of the eyes, nose or mouth.

The only way to diagnose leptospirosis is by blood tests a few weeks apart. Animals that have been identified as carrying the disease should be treated with vaccine and streptomycin under the supervision of a veterinarian.

Leptospirosis can be prevented by implementing a vaccination program. All cattle should be vaccinated annually and calves should be vaccinated at marking and weaning. Any new cattle introduced to the property should also be vaccinated.

**Vibriosis**

*(Campylobacteriosis)* This is a sexually transmitted disease of cattle causing abortion of embryos and unsynchronised oestrus cycles. It is caused by the bacteria *(Campylobacter fetus venerealis)*.

*Campylobacteriosis* can be diagnosed and treated by a veterinarian. It can be prevented by implementing a vaccine program.
1. Identify three sheep and/or cattle diseases that occur on farms in your district.
   a) 
   b) 
   c) 

2. For each of these diseases, state the signs that farmers look for to identify them.
   a) 
   b) 
   c) 

3. For each of these diseases, describe the treatments that farmers can use to control them.
   a) 
   b) 
   c)
Integrated Pest Management (IPM) is the use of many different control methods together to control pests that reduce the efficiency of animal production. It is aimed to be more environmentally friendly than simply applying chemicals to control pests and also to reduce farmers’ reliance on the use of chemical treatments, hopefully reducing the rate at which pests become resistant to chemicals used to control them.

An integral part of IPM is to maintain the pests at a level below the economic injury level. What is meant by the term ‘economic injury level’?

IPM can be applied to the control of lice on sheep. There are four main strategies involved. Describe each of these strategies in detail:

a) Improved host resistance –

b) Improved management –

c) Biological control –

d) Selective use of chemicals
**Materials Required**
- Obtain a rumen from an abattoir
- Scissors
- Gloves
- Binocular microscope
- Petri dishes
- Microscope slides
- Dissection tray
- Slide cover slip

**Method**

1. Put the gloves on your hands. Lay the rumen in the dissection tray and identify the oesophagus, rumen, reticulum, omasum, abomasum and small intestine.

2. Using the scissors carefully cut down the oesophagus and across the rumen wall. Make a drawing of what the inside of the rumen wall looks like, then make a note what the rumen contents smells and looks like.

3. Using a pipette take some of the rumen liquid and place in a petri dish and set aside.

4. Carefully continue cutting through the rumen and cut across the reticulum wall. Draw what the inside of the reticulum wall looks like.

5. Carefully continue to cut through the reticulum wall and cut across the omasum wall. Draw what the inside of the omasum looks like.

6. Finally cut through the remainder of the omasum wall and across the abomasum wall. Draw what the inside wall of the abomasum looks like.

7. Place a drop of rumen liquid from the petri dish on a microscope slide. Gently place the cover slip over the drop of liquid. Place the slide on the stand of the microscope and examine the contents of the liquid. Draw and label what you see. Place a scale next to your drawing.

8. Make sure that the rumen and it’s contents are disposed of carefully and safely.
Rumen Dissection Questions

1. Why does the rumen smell so strongly?

2. The rumen is the largest part of the stomach system of ruminants. Why is this so?

3. What is the role of the reticulum?

4. What is the purpose of the ‘pages’ in the omasum?

5. What part of the monogastric digestive system is similar to the abomasum?

6. Research the microorganisms that can be found in the rumen. Identify any microorganisms that you saw under the microscope.
CASE STUDIES
1. Kojonup
2. Narrogin
3. Darkan

Planning and Running an Evaluation
Reporting on an Evaluation

This Section
Case Study One - Kojonup

The objective of the evaluation was to compare strip grazing wethers at 25 DSE/ha with set stocked wethers at 11 DSE/ha with the aim of increasing wool cut/ha. Also to provide a benchmark for strip grazing to compare other operations on the property. The third objective was to test a proven strategy to increase wool production to determine whether it would fit into the whole farm system.

The present low profitability of the wool industry doesn’t allow any margin for error therefore all alterations to the system must be properly evaluated. Woolpro has provided invaluable support in this evaluation, assisting with economic and practical support.

The wethers used in the evaluation were run together and given the same diet prior to the break of the season. They were then randomly placed into two groups. Group 1 was set stocked at 11 DSE/ha and group 2 strip grazed at 25 DSE/ha. Both pastures were treated with 140 kg/ha of super phosphate plus agsel.

Both groups had 1500 kg DM/ha of FOO when they were split up. The set stocked wethers had up to 4000 kg DM/ha FOO during the spring flush. They were given approximately 1 kg/head/day of dry matter. This was done with electric fencing and by moving the sheep every second day until October when they were set stocked in the same paddocks at 25 DSE/ha.

As shown in the table on pg90 the strip grazed wethers proved more profitable when compared to set stocking over a six month period or the whole year. Other benefits include the lowering of micron and vegetable matter.

Conclusions:
• Less room for selective grazing
• Deeper root systems on the plants
• Strip grazing has proven to be a means to overcoming early season feed deficits.

Strip grazing fits very well into the whole farm system. It allows you to address the winter feed gap by either running more sheep or giving your ewes more area and thus reducing supplementary feeding. By having the extra sheep you have the flexibility to manage the spring flush without the need to buy sheep and risking disease eg. footrot. Strip grazing mobs can be used as a tool to graze various problem areas on the farm corners of paddocks where the capeweed is dominant and the sheep in that paddock have neglected it.

This is also useful in preparing paddocks prior to cropping by setting up a clover dominant pasture and reducing insect problems.

Laneways and other areas can be grazed quickly and effectively therefore not tying these areas up for lengthy periods.
### Half Years Production. Winter

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<th>Set stocked wethers</th>
<th>Year’s production</th>
<th>6 monthsprod. winter</th>
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<tbody>
<tr>
<td>DSE/ha</td>
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<tr>
<td>Shearing</td>
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<tr>
<td>Drenching</td>
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<td>Crutching</td>
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Case Study Two - Narrogin

The objectives of the ongoing evaluation are to:

- establish and then sustain higher production levels and to produce more wool per hectare,
- have more sheep for sale and more meat, and
- learn to manage the pasture/stocking phase to benefit the cropping phase.

In 1996, a paddock was selected that had similar soil types and could be split in two. The control paddock has had a standard annual application of 100 kg/ha plain super and was stocked at about 8.5 DSE per winter grazed hectare (wgha).

The Woolpro paddock received 100 kg/ha plain super plus 60-76 kg/ha of muriate of potash applied annually. In 1996 it also received 1.2 t/ha of lime. It was spraytopped and pasture manipulated (redlegged earth mite control included) to control silvergrass, barley grass and geranium. With the added inputs, stocking rates were set at least 20% higher than the control paddock.

The evaluation has achieved the first objective by showing higher production levels are possible. The Woolpro paddock achieved a higher wool cut per hectare (46% higher than control) and a higher lambing percentage (30% higher) although stocked at a higher stocking rate.

Despite higher input costs the higher production more than paid for itself. Over the three years the gross margin was 20% higher.

The Woolpro paddock has achieved higher productivity, is clover dominant and set up ideally for the cropping phase in 2000.

Applying the techniques from the Woolpro evaluation the whole farm stocking rate has been increased to better utilise pasture and help manipulate the pasture to benefit the cropping phase. It has shown the benefits of:

- later lambing,
- deferred grazing,
- additional fertiliser (correcting deficiencies),
- chemical manipulation and RLEM control.

By understanding the benefits of these tactics, you can improve total productivity.

**SUMMARY OF RESULTS - 1996 to 1998**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Woolpro</td>
<td>Control</td>
<td>Woolpro</td>
<td>Control</td>
<td>Woolpro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GM/ha</td>
<td>$169.91</td>
<td>$165.52</td>
<td>$165.46</td>
<td>$216.31</td>
<td>$137.62</td>
<td>$180.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stocking rate (DSE/wg ha)</td>
<td>8.8</td>
<td>10.6</td>
<td>8.8</td>
<td>10.6</td>
<td>7.9</td>
<td>10.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wool cut/ha (kg/ha)</td>
<td>32.5</td>
<td>39.1</td>
<td>30.3</td>
<td>39.9</td>
<td>29.4</td>
<td>43.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambing%</td>
<td>75</td>
<td>95</td>
<td>87</td>
<td>91</td>
<td>83</td>
<td>113</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number prime lambs turned off at first draft (%)</td>
<td>44 (59%)</td>
<td>84 (79%)</td>
<td>41 (51%)</td>
<td>79 (58%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOO (kg DM/ha) (date recorded)</td>
<td>2300 (1/9)</td>
<td>2500 (1/9)</td>
<td>1350 (25/5)</td>
<td>1760 (25/5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture composition (%clover, grass and broadleaf)</td>
<td>C - 15%</td>
<td>C - 41%</td>
<td>C - 56%</td>
<td>G - 15%</td>
<td>G - 37%</td>
<td>G - 6%</td>
<td>BL - 70%</td>
<td>BL - 22%</td>
</tr>
</tbody>
</table>
Case Study Three - Darkan

This evaluation examined whether deferred grazing is a profitable option.

The paddocks being deferred comprised 140 ha. Using 1560 green tag wethers the effective stocking rate was 11.1 DSE/ha (the paddock has traditionally been stocked at 8.57 DSE/ha). The wethers were fed on hay, lupins and oats in a small paddock which contains trees. The pasture in the deferred paddock was allowed to reach 1400 kg/ha of FOO before the sheep were put on to it.

The animals were fed for 35 days with a total cost of $3998. Cost/head was $2.56 or $0.07/day. Cost/ha of the feeding was $28.55. With a gross margin of $15.00/DSE an extra 1.9 DSE/winter grazed hectare is required to break even. The stocking rate was increased by 2.57 DSE/ha or an extra $10.00/ha was achieved by deferred grazing.

Hay was cut for supplementary feeding while paddocks were being deferred, and the evaluation was run again with wethers in 1998 in a similar way to 1997.

(Sourced from Woolprose Issue 8, March 1998)
The first step in setting up an evaluation is to decide which part of the sheep enterprise to examine. This could be drawn from a part of the enterprise that the students feel could be made more efficient or from the syllabus to meet practical requirements. As Woolpro focuses on productivity and profit per hectare, these could be good themes on which to base the evaluation.

The next step is to plan the evaluation.

Some questions to consider in this step include:

What is the aim of the evaluation?
Which paddock/s will be used?
How much FOO is in the paddock?
What is the benchmark (minimum) FOO?
How fast is the pasture growing?
What class of stock will be used?
How many sheep will be used?
What is the body condition score of the sheep?
How often will measurements be taken?
Will the number of stock be altered at any time during the evaluation?
What data will be collected during the evaluation?

When writing the plan always keep the aim of the evaluation in mind. Map out the steps to be taken in the evaluation, noting the minimum FOO requirements of the paddock to ensure that the stock used will always have sufficient feed for their requirements. Students can be responsible for this process but make sure they have a reason for each of the restraints that they place on the evaluation. Your Woolpro advisor should be able to help you to decide on an appropriate evaluation and help with the planning of it.

Refer to the Woolpro Paddock Manual for more information about planning and running an evaluation.
The report produced at the conclusion of an evaluation allows students to bring together the data collected during the evaluation and show their understanding of the purpose and results of the evaluation. It involves the use of language, literacy and numeracy skills.

The aim of the evaluation should be clearly stated at the beginning of the report. This can be followed by the method(s) used during the evaluation to meet the aim, including how and when data was collected. The data collected can then be presented in tables or graphs.

Results of the evaluation can then be reported. This should involve referring to the data collected and the students’ interpretation of their meaning. The results can be discussed regarding their fulfilment of the aim.

Students can then suggest whether they found the evaluation to be successful and how it could be improved if it were to be performed again. They may also suggest a further evaluation to build upon the results that were obtained in the evaluation they performed.

The report can be presented in many forms including a poster, an oral presentation, video or a written document.
Glossary and References

Further Reading

Farmnotes
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abscess</td>
<td>gathering of pus in one part of the body</td>
</tr>
<tr>
<td>Anaerobic</td>
<td>containing no oxygen</td>
</tr>
<tr>
<td>Awn</td>
<td>long bristle like attachment to a seed covering</td>
</tr>
<tr>
<td>Bolus</td>
<td>chewed and partially digested food</td>
</tr>
<tr>
<td>Cellulose</td>
<td>highly fibrous carbohydrate content of plant cell walls</td>
</tr>
<tr>
<td>Dock</td>
<td>to remove a tail</td>
</tr>
<tr>
<td>Elastrator rings</td>
<td>thick elastic bands used to cut off testicles and tails</td>
</tr>
<tr>
<td>Faeces</td>
<td>solid waste produced by an animal</td>
</tr>
<tr>
<td>Fermentation</td>
<td>the breaking down of materials by micro-organisms in an anaerobic environment</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>any product that adds nutrients to the soil</td>
</tr>
<tr>
<td>Foetus</td>
<td>a developing animal in a uterus</td>
</tr>
<tr>
<td>Gestation</td>
<td>period from conception to birth</td>
</tr>
<tr>
<td>Hay</td>
<td>dried plant material that is fed to animals as supplementary feed</td>
</tr>
<tr>
<td>Immunity</td>
<td>resistance to a disease</td>
</tr>
<tr>
<td>Infiltration</td>
<td>the movement of water from the soil surface into the soil</td>
</tr>
<tr>
<td>Joining</td>
<td>the period of time that male and female animals are put in the same paddock</td>
</tr>
<tr>
<td>Libido</td>
<td>desire of animal to have sexual intercourse</td>
</tr>
<tr>
<td>Lousicide</td>
<td>chemical administered to animals to control lice</td>
</tr>
<tr>
<td>Maintenance ration</td>
<td>a diet with an energy and nutrient content sufficient to allow the animal</td>
</tr>
<tr>
<td></td>
<td>to move and to meet the requirements of the body to survive (without putting on weight)</td>
</tr>
<tr>
<td>Micro-organisms</td>
<td>tiny organisms that can only be seen with the aid of a microscope, these</td>
</tr>
<tr>
<td></td>
<td>include bacteria, protozoa and fungi.</td>
</tr>
</tbody>
</table>
GLOSSARY

Muster – to collect a group of animals together
Nematode – round worms, some of which are that are parasitic on animals
Oestrogen – a female hormone
Parasite – animal or plant living from another plant or animal
Ped – the smallest structural unit of soil
pH – a measure of the acidity or alkalinity
Pinnate – tiny finger like projections that make up leaves
Pore – the space in the soil between peds
Production ration – food with an energy and nutrient content above maintenance to allow the animal to grow and produce (eg. grow wool, produce milk, put on weight or to produce a calf or lamb)
Prostrate – growing close to the ground
Regurgitate – to return food to the mouth from the stomach
Ruminant – animals that have four stomachs and are able to digest a high proportion of cellulose eaten.
Scour – diarrhoea
Silage – plant material that has been harvested while green and fermented, then fed to animals as supplementary feed
Transpiration – the evaporation of water from the leaves of plants
Tufted – leaves and stems growing closely together
Tussock – growing in a large clump
Vaccination – an injection of a vaccine to produce immunity to a disease
Weaning – the removal of young animals from their mothers, end of the period of feeding on mothers milk
FURTHER READING

Written Material
Australian Soil Fertility –CSIRO Publishing
Beef Production Guide (Home Study Program) –NSW Agriculture
Low Residue Control of Lice and Flies –The Woolmark Company
New Developments in Serradella –Agriculture Western Australia
Perennial Grasses for Animal Production in the High Rainfall Areas of Western Australia –Agriculture Western Australia
Perennial Pastures for areas receiving less than 800mm annual rainfall –Agriculture Western Australia
Prime Pasture Programme –NSW Agriculture, National Landcare Program, Incitec Fertilizers, Monsanto, Primary Sales Australia and Wrightson Seeds
Prograze: Profitable, sustainable grazing –NSW Agriculture, Agriculture Western Australia, International Wool Secretariat, Meat Research Corporation, Natural Resources and Environment Victoria, Primary Industries and Resources SA and Department of Primary Industry and Fisheries Tasmania
Sheep Management –P.Ward and J.Marwick
Sheep Management and Wool Technology –J.B D’arcy
Wool Production Guide –Elders Wool
Woolpro Paddock Manual –Agriculture Western Australia
Woolpro Reference Manual –Agriculture Western Australia
Internet Sites

Agriculture Western Australia
– www.agric.wa.gov.au

Aus-Meat Limited
– www.ausmeat.com.au

Cattlecare

Centre for Legumes in Mediterranean Agriculture
– www.clima.uwa.edu.au

Department of Animal Science Oklahoma State University
– www.anzi.okstate.edu

Department of Primary Industries QLD
– www.dpi.qld.gov.au

Flockcare

Landcare Issues

National Farmers’ Federation
– www.farmwide.com.au

Natural Resources and Environment Victoria
– www.nre.vic.gov.au

NSW Agriculture
– www.agric.nsw.gov.au

Primary Industries and Resources SA
– www.pir.sa.gov.au

Safety on the Farm
– www.saftek.com/worksafe/farm

The Woolmark Company
– www.wool.com.au

Woolpro
LIST OF FARMNOTES

22/84  Collection and preservation of insects
65/91  Selection of supplementary feeds
65/94  Lucerne - queen of forages
69/94  Body condition scoring of sheep and goats
39/97  Breeding and raising more lambs
6/98   Footrot eradication in Western Australia
7/98   Understanding benign footrot in sheep
31/98  Caprera Crimson Clover
26/99  Establishing Balansa and Persian clovers on waterlogged, mildly saline soils
98/99  Fodder conservation as silage
1/2000 FACT SHEET Commonly used chemicals to treat sheep lice and blowflies
13/2000 Farmnote 13/2000 Sheep Lice - Cost effective Mxt whilst minimising residue
49/2000 Systems for browsing sheep on the perennial fodder shrub Tagasaste
50/2000 The feed value of perennial fodder shrub Tagasaste