Book 2

Year 11

Agricultural Science

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GOVERNMENT OF SAMOA
MINISTRY OF EDUCATION, SPORTS AND CULTURE

Acknowledgements

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Original drawings by: Anna Egan-Reid

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INTRODUCTION

This is the second and last student book for Year 11. Each Year 11 student book covers three strands in the curriculum statement and there are three main parts to this book:

- Animal production.
- Farm management, economics and marketing.
- Tools, equipment and facilities.

Part One of the book covers cattle breeds, nutrition, health and management. Part Two covers production functions, partial budgeting and marketing, and Part Three covers tools and equipment.

Unit 1: HISTORY AND IMPORTANCE OF CATTLE PRODUCTION

About this unit

This unit covers the history of cattle production in Samoa. It also covers the importance of cattle production and uses of products from cattle. Students will have the opportunity to find out where cattle farms are located and be able to name the external parts of cattle. Some of the major problems faced by cattle farmers are also discussed.

History Of Cattle Production

Cattle were introduced to Samoa in the late 1800s. Originally they were kept on coconut plantations to control weeds. Cattle were kept mainly by missions, early settlers and plantation owners. In the 1970s the government of Samoa promoted cattle development by both small and large cattle holders. Today there are many cattle farms around the country. They receive a lot of help from the livestock division of the Ministry of Agriculture, Forestry, Fisheries and Meteorology (MAFFM).

Breeds are imported from Australia regularly to try and improve local breeds. However, even though we have many cattle farms in Samoa, we still do not produce enough cattle to satisfy the local demand for beef and dairy products.

The External Body Parts Of Cattle

As you study and talk about cattle it is important for you to be able to correctly identify and name the external parts of cattle. Figures 1.1 and 1.2 show the external parts of *Bos indicus* and *Bos taurus* cattle.

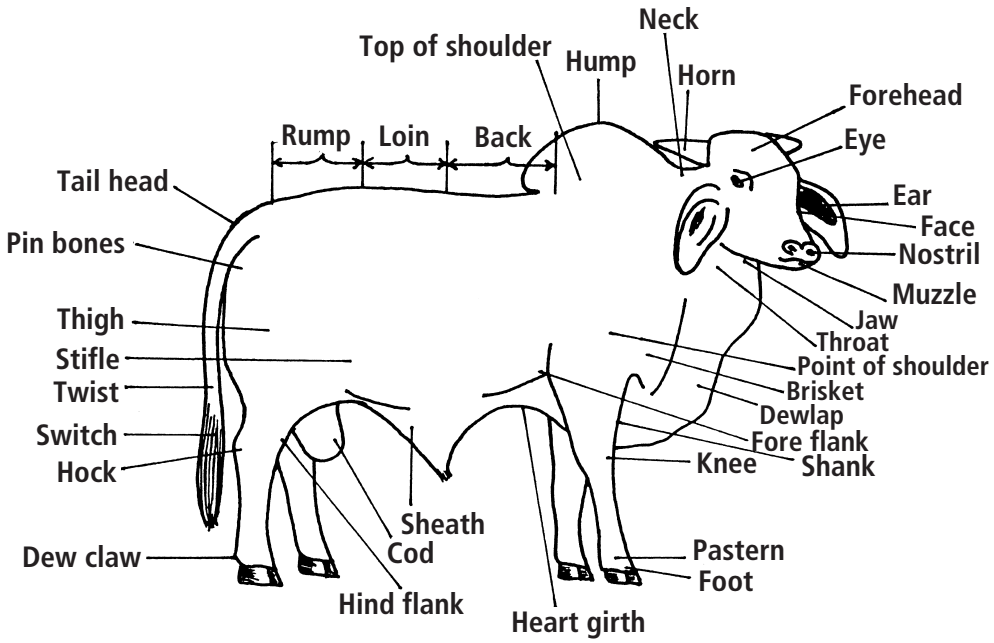


Figure 1.1
Bos indicus.

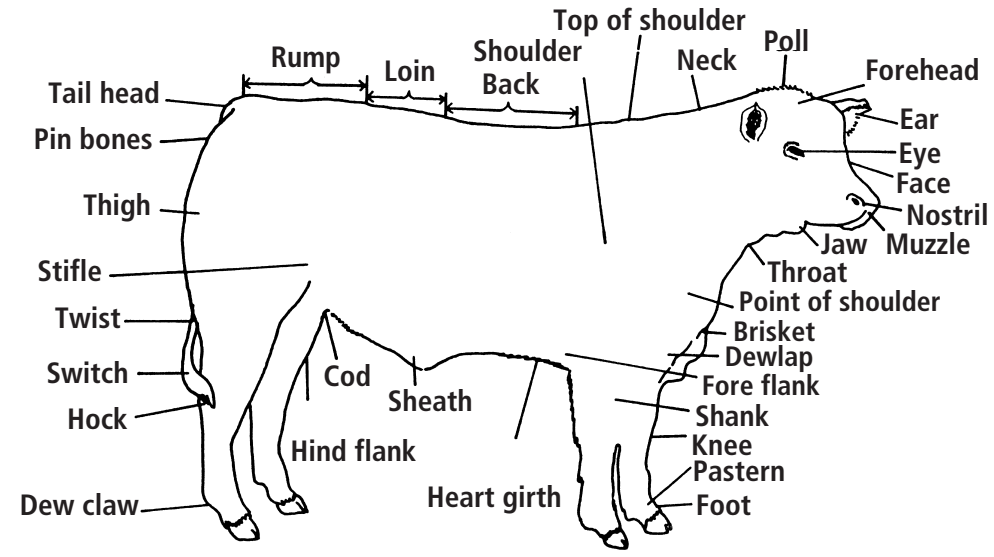


Figure 1.2
Bos taurus.

Importance Of Beef Cattle In Samoa

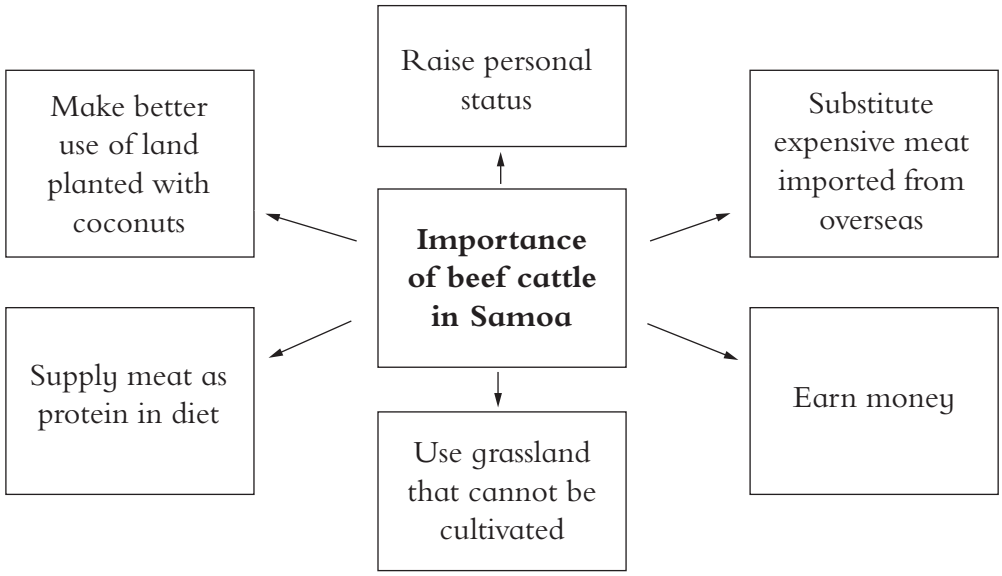


Figure 1.3
Mind map for the importance of beef cattle.

Products Of Beef Cattle

The Figure below shows the main products that come from beef cattle.

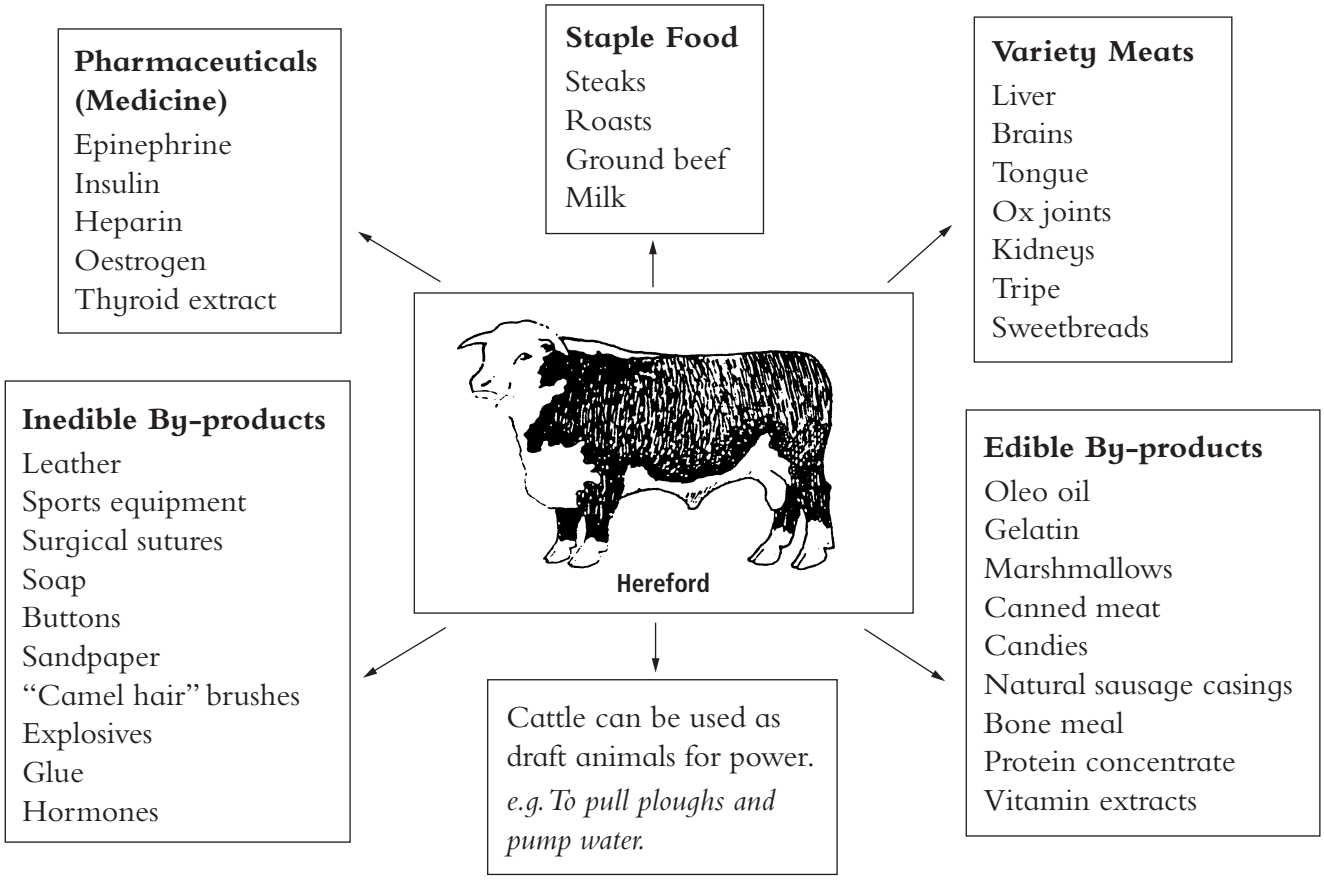


Figure 1.4
Products of beef cattle.

Major Problems Faced By Cattle Farmers

There are many problems that affect the productivity and profitability of cattle farms, but many can be overcome with good management. Some of the most common problems are listed below:

- **Social pressures**
  As members of extended families, cattle farmers are regularly asked by chiefs (matai) of the family to donate cattle for traditional feasts and ceremonies (fa'alavelave).

- **Physical problems**
  Poor quality pasture, water supply, and difficulty in transporting animals to market are all local problems. Samoa is hilly and stony and has very little flat, fertile land suitable for cattle farming. It is often difficult to maintain a supply of good, clean water and many access roads to farms are rough.

- **Diseases and parasites**
  Tropical conditions of hot, humid weather create the right conditions for the development and growth of common diseases, parasites and fungi.

- **Financial problems**
  It can be difficult to raise capital for projects such as constructing and maintaining fences and yards.

- **Resistance to change**
  Farmers stay with traditional growing practices and the belief that other enterprises (such as cocoa, chicken and kava) provide more profit. Most farmers are not well-trained, and are not able to make sound economic decisions about which enterprise to pursue.

- **Lack of knowledge and skills in raising cattle**
  Most farmers have not been trained to raise and manage cattle and do not have the management skills required to keep cattle profitably.

Activity 1 The History And Use Of Cattle

Materials needed:
Pen/pencil/coloured pens;
Newsprint/cardboard.

Aim To understand the benefits of farming cattle.

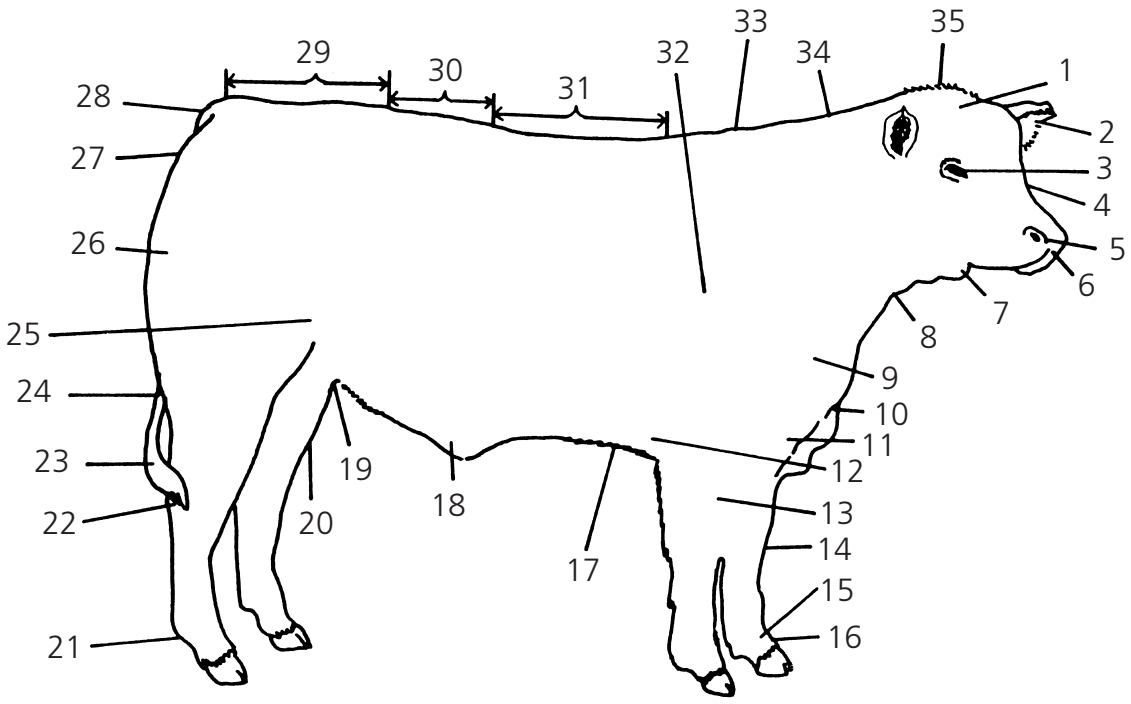
1. Divide into groups of three. One person can be the recorder for the group, one person can lead the discussion, and the third person can be the reporter for the class discussion.
2. Discuss the history of cattle production in Samoa and list the main events that took place in the development of the cattle industry. Think about who brought cattle to Samoa, why they brought cattle to Samoa, and what breeds were brought to Samoa.
3. On a large sheet of paper, draw a mind map similar to Figure 1.3 showing the main reasons why farmers keep beef cattle.
4. The reporter from each group presents the mind map to the whole class.

Activity 2 External Parts Of Cattle

Materials needed:
Coloured pens/pen/pencil;
Newsprint/cardboard;
Scissors;
Sticky tape.

Aim To identify the body parts of cattle.

1. In groups of three look at and discuss the external body parts of both *Bos indicus* and *Bos taurus* beef animals in Figures 1.1 and 1.2.
2. Make labels of all the cattle parts listed below and divide them into three lots. Take one lot each. Draw a large figure of a cattle beast on cardboard or newsprint. Without looking in your book, put your labels in the right place, taking turns, one at a time. Let another group check your labelled figure and give you a mark for each label in the correct place. Make corrections if there are any.



1. Forehead
2. Ear
3. Eye
4. Face
5. Nostril
6. Muzzle
7. Jaw
8. Throat
9. Point of shoulder
10. Dewlap
11. Brisket
12. Fore flank
13. Shank
14. Knee
15. Pastern
16. Foot
17. Heart girth
18. Sheath
19. Cod
20. Hind flank
21. Dew claw
22. Hock
23. Switch
24. Twist
25. Stifle
26. Thigh
27. Pin bones
28. Tail head
29. Rump
30. Loin
31. Back
32. Shoulder
33. Top of shoulder
34. Neck
35. Poll

Figure 1.5
External parts of cattle.

Activity 3 Location Of Cattle Farms

Materials needed:
Pen/pencil/coloured pens;
Map of beef farms in Samoa.

Aim To find out where the beef farms in Samoa are located.

1. In the same groups of three draw an outline of Upolu and Savai'i, the two main islands of Samoa, and copy it in your exercise book.
2. Using the relief map of Samoa below, discuss, locate and mark out the areas you think would be suitable for beef farming.
3. Compare your map with the map provided by your teacher that indicates the actual location of beef farms in Samoa.
4. Mark the actual location of beef farms on the map in your exercise book.

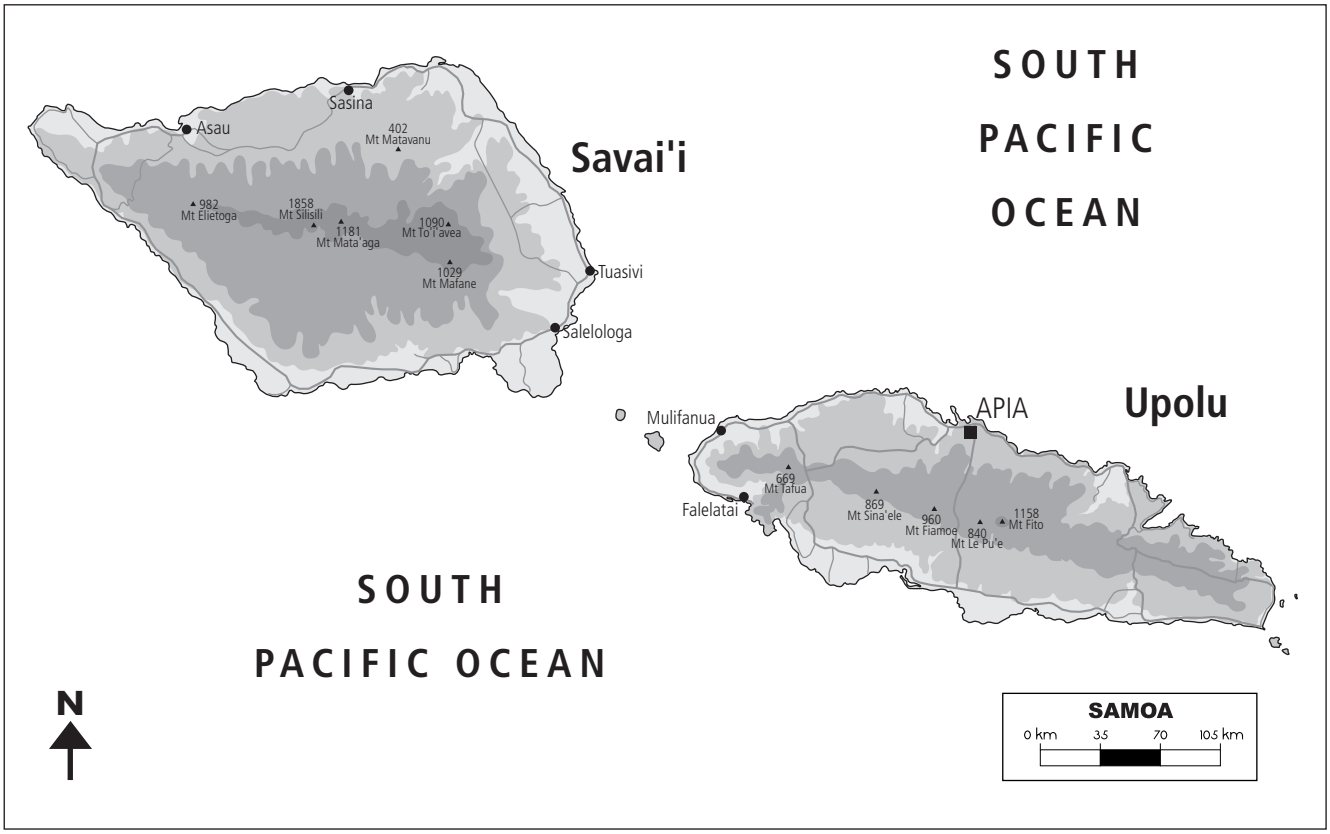


Figure 1.6
Relief map of Samoa.

Review

1. Describe the future trends of cattle production in Samoa.
2. List the reasons why farmers keep cattle.
3. List potential products from cattle that can be exported.
4. Explain the risks faced by cattle farmers and describe how they can be managed.
5. Draw a sketch of Upolu and Savai'i and label areas suited to cattle farming.

Unit 2: CATTLE BREEDS AND BREEDING

About this unit
Breed is one important factor to improved cattle production. In this unit students will compare different scales of cattle production operations. They will identify cattle breeds and their different characteristics, and select suitable cattle breeds for different purposes. This unit also covers reproduction, mating methods and calving.

Agricultural Enterprise Groups

The cattle industry in this country can be classified into three main agricultural enterprise groups depending on the size or scale of the operation:

- Small holder. This group has subsistence-level rates of production and earns cash income. Small holders use land that is unsuited for other uses such as growing crops. They also depend on family labour. Cattle herds are small, often made up of ten cattle or less. Sometimes the cattle are tethered around the backyard or around the village and provide a source of protein for villagers.
- Semi-commercial. Usually community-based, this group of cattle farmers use alienated and/or customary land unsuited for other uses. Herd numbers range from 10–25 cattle. They use community or tribal labour. Cattle raised in this way are one of the main sources of protein for communal gatherings and ceremonial activities.
- Large-scale commercial. These farms are owned by individuals, companies or the government. They employ highly-skilled labour and herds are larger, usually with 75 cattle or more.

The following table shows the production level of small holder, semi-commercial and large-scale commercial systems of cattle production. The large-scale enterprises produce more beef or milk per cattle unit, compared to the semi-commercial and small-holder enterprises.

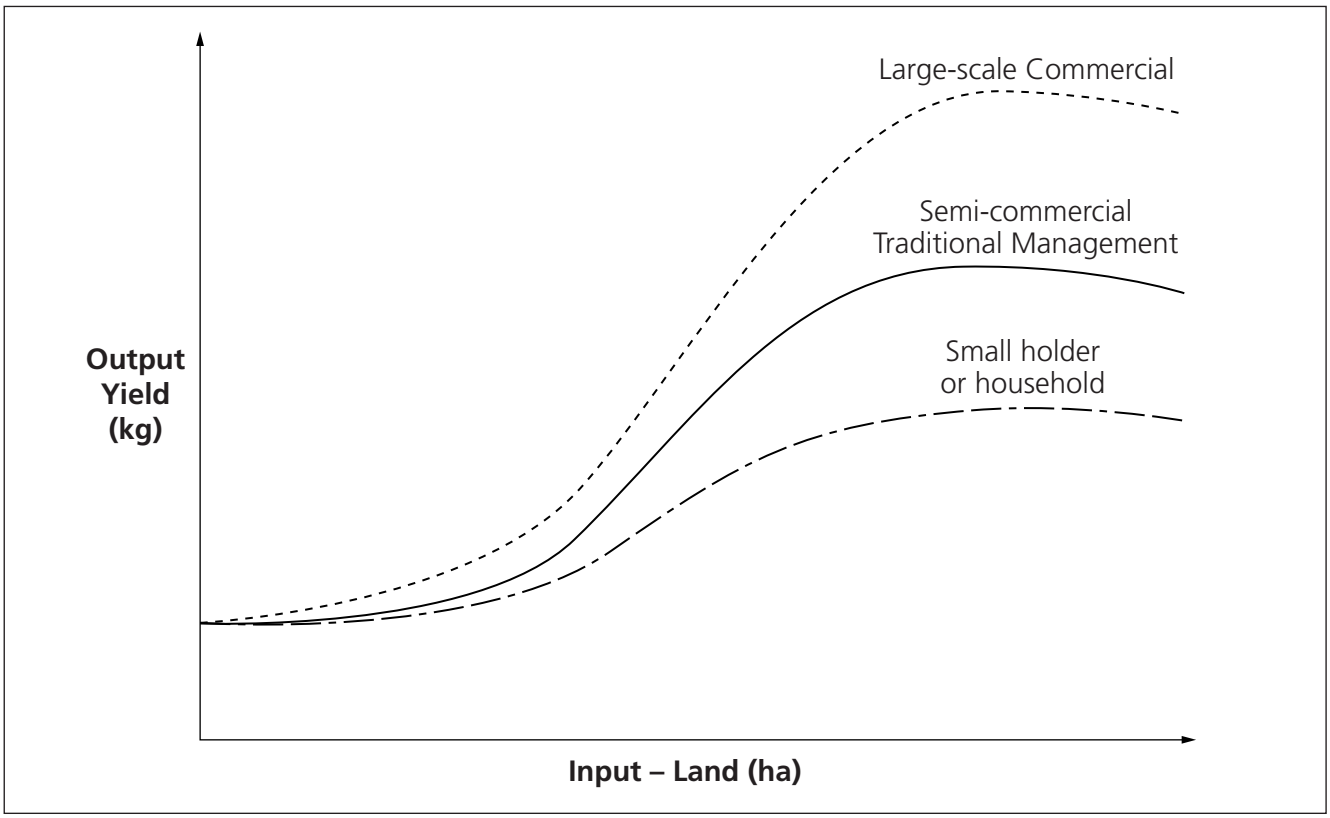


Figure 2.1
Production rates of three types of beef enterprise.

Breeds Of Cattle

Bos taurus (Bt)	*Bos indicus* (Bi)	Crossbreed (Bt x Bi)
Originated from Europe. Adapted to temperate climate. Has dark or red coat. Long and thin hair. Short thick head. Few sweat glands. Small horizontal ears. Fat over whole body. Straight top line. Either horns out and forward or polled. Early sexual maturity (8–12 months). Short and thick body. Has large calves. Forehead dished. Not so intelligent. Little loose skin. Strong herd instinct. Needs good pasture (food). Unpigmented skin. Not tick resistant. Bellows or lows. Susceptible to bloat. Eyes exposed. Puts on fat easily. Shorter and stockier legs. Hips wide apart.	Originated from Asia. Adapted to tropical climate. Usually light coloured. Short fair hair. Long narrow head. Large hanging ears. Has large area of loose skin. Many sweat glands. Has hump. Stores fat in hump. Horns out and upward. Late sexual maturity (18 months). Tall and narrow body. Has small calves. Forehead broad and flat. More intelligent. More individual. Pigmented skin. Tick resistant. Makes a grunting noise. Bloat resistant. Eyes protected by pad of fat and skin. Very difficult to fatten. Longer legs. Hips inclined to be narrow. Good digestion of poor pasture.	Adapted to tropical and temperate climate. Mixed coat. Long broad body. Some extra loose skin. Eyes protected. Straight top line with a hump (some cases). Resistant to tick. Resistant to bloat. Early sexual maturity (7–12 months). Puts on fat easily. Has large calves. Good digestion of poor pasture. More intelligent. Hips wide apart. Many sweat glands. Vigorous growth. High productivity.

Figure 2.2
Characteristics of Bos taurus, Bos indicus *and crossbreeds.*

***Bos taurus* breeds**	***Bos indicus* breeds**	**Crossbreeds**	**Breeds suited to local conditions**
Polled Hereford Angus Polled Shorthorn Shorthorn Red Poll Murray Grey Hereford Shorthorn Devon Charolais Lincon Red Simmental	Brahman Indu-Brazil Javanese Zebu Sahiwal Sindhi Africander	Braler Charbray Red Brangus Brangus Braford Santa Gertrudis Brazona Droughtmaster Brahmental Simbrah American breed	Droughtmaster Brahman Braford Santa Gertrudis Brangus

Figure 2.3
Examples of Bos taurus, Bos indicus *and Crossbreed cattle.*

The breeds listed in column 4 in Figure 2.3 are suited to conditions in Samoa: they can tolerate high temperatures, are partially or fully tick resistant, eat local pasture types, and have a high feed-to-body-weight conversion ratio.

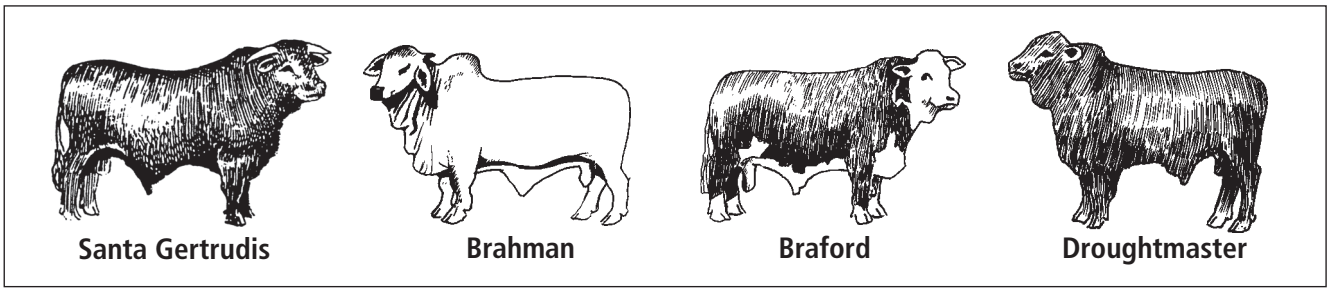


Figure 2.4
Breeds common in Samoa.

Dairy Breeds

The two common dairy breeds are Holstein Friesian and Jersey. The main characteristics of the two dairy breeds are shown in the table below.

Breed	Mature cow size (kg)	Milk production in litres	% butter fat	Size of calves (kg) at birth	Colour	Native home
Holstein Friesian	500–650	70,000	3–4	40–50	Black and white	Holland
Jersey	300–500	50,000	4–5	20–30	Fawn with or without white	Isle of Jersey

Figure 2.5a
Dairy breed characteristics.

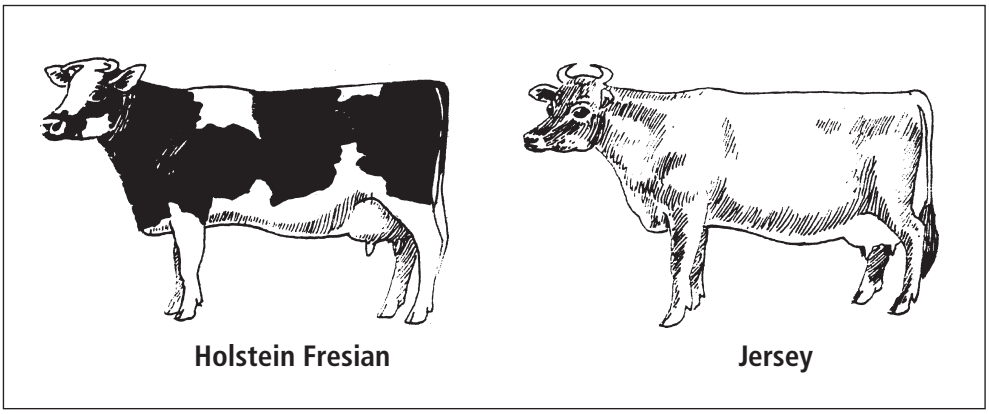


Figure 2.5b
Dairy breeds.

Reproduction

Oestrus
As with many mammals, the cow has a recurring cycle of sexual receptivity and fertility, and this is known as oestrus. Other ways of saying it are that a cow has 'come into season' or is 'on heat'.

Recurrence of oestrus
In cows, this cycle is about 21 days (18–24 days). (This is the time from one heat period to another.)

Length of oestrus
A cow is on heat for approximately 14 hours in each cycle (10–18 hours).

Gestation period
This is the period of time from fertilisation of an egg to the birth of a calf (calving). It is approximately 280 days (nine months). It is also called the period of pregnancy.

Sexual maturity of mating heifers and bulls
This varies in different breeds:

- **European breeds**
  These breeds become sexually mature between the ages of nine and 15 months. It is recommended that heifers are not mated before they are 300 kg in weight (around 15 months of age).
- **Brahman breeds**
  These breeds become sexually mature between the ages of 15 and 18 months. It is recommended that heifers be mated when they are 22–24 months of age.

Bull: cow mating ratio
Young bulls should be used on small herds only i.e. one bull to 15 heifers.

The ratio for mature bulls is one bull to 25 cows.

Identification of pregnant cows
A pregnant cow can be identified in two ways:

- By visual appraisal (looking carefully for known signs), which requires a lot of experience.
- By pregnancy testing, which needs to be done by a trained person, for example a veterinarian (see Figure 2.6).

Signs of successfully mated cows
A successfully mated cow will stop having heat periods, put on weight and become sluggish, particularly towards the end of pregnancy.

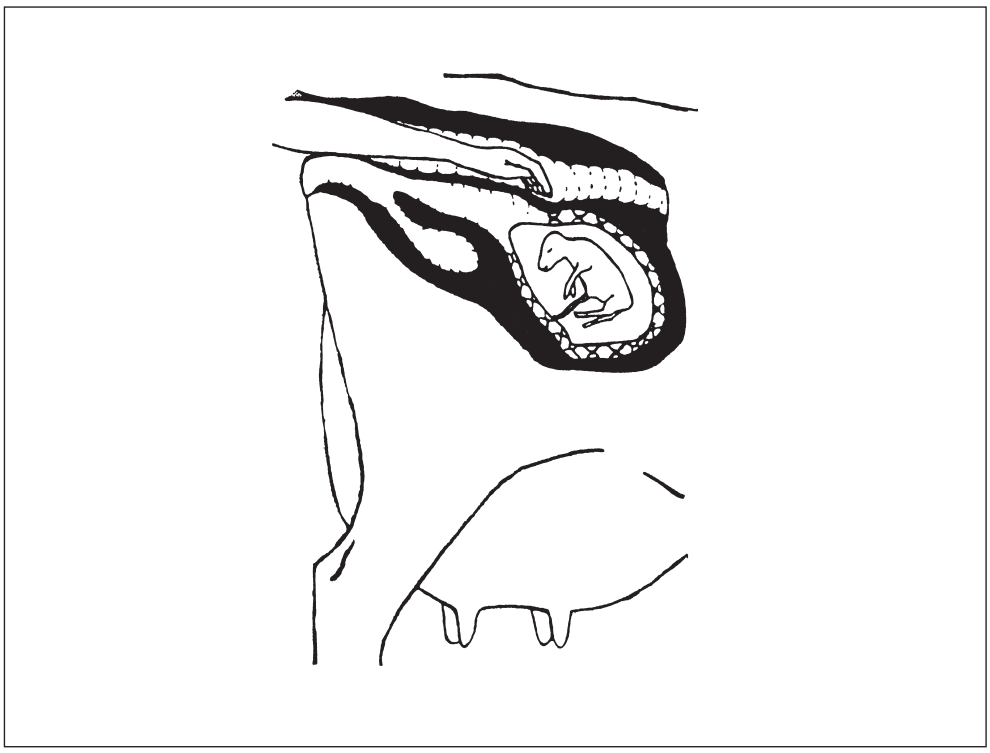


Figure 2.6
Checking pregnancy in cattle.

Signs of approaching calving
Some signs that a cow is about to give birth are:

- Udder enlargement. 2–4 weeks before birth in mature cows, and from five months of pregnancy in heifers the udder swells.
- Vaginal discharge. From seven months on there is a sticky, stringy, clear discharge from the vagina. It becomes more profuse as calving approaches.
- Relaxation of the pelvic ligament. This is very marked in the last 1–2 days.
- Swollen vulva and possibly the abdomen. This is noticeable during the last few days of pregnancy.
- Colostrum. This cloudy, yellow milk leaks from the udder during the last few hours before calving.
- The cow becomes restless and does not eat close to the commencement of labour.
- The animal wanders away from the herd to seek a quiet place to calf.

Birth of calves and afterwards

Usually a cow can give birth to a calf without help. Sometimes, however, a heifer producing her first calf may have trouble and need some help. If the calf has an abnormal presentation (is in the wrong position), then you will have to help.

This is what you will need to do:

1. Wash your hands.
2. Wash the vulva area of the cow.
3. Push the calf back in and try to turn it so that it presents in a normal way. If the calf is the right way round with nose and both front feet coming first, you can pull by hand, or with ropes, to help the calf out. **Never** pull with a tractor or truck.
4. After calving, the cow will stand up and start to lick the calf.

Once the calf is cleaned by the mother it should be ready to walk and find the udder (within 15 minutes). It is essential that the calf suckles the mother within the first few hours to receive colostrum, which provides energy and resistance to disease.

During the lactation period the mother needs good pasture to maintain milk supply. Calves should be weaned at 5–8 months of age.

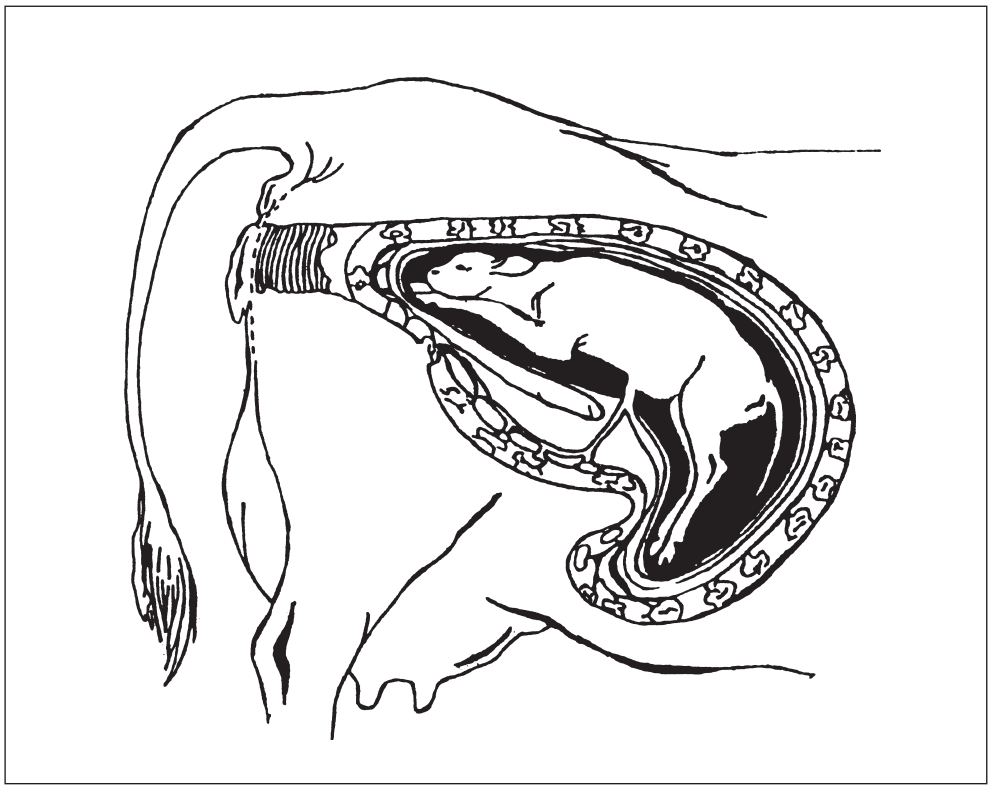


Figure 2.7
Normal birth position.

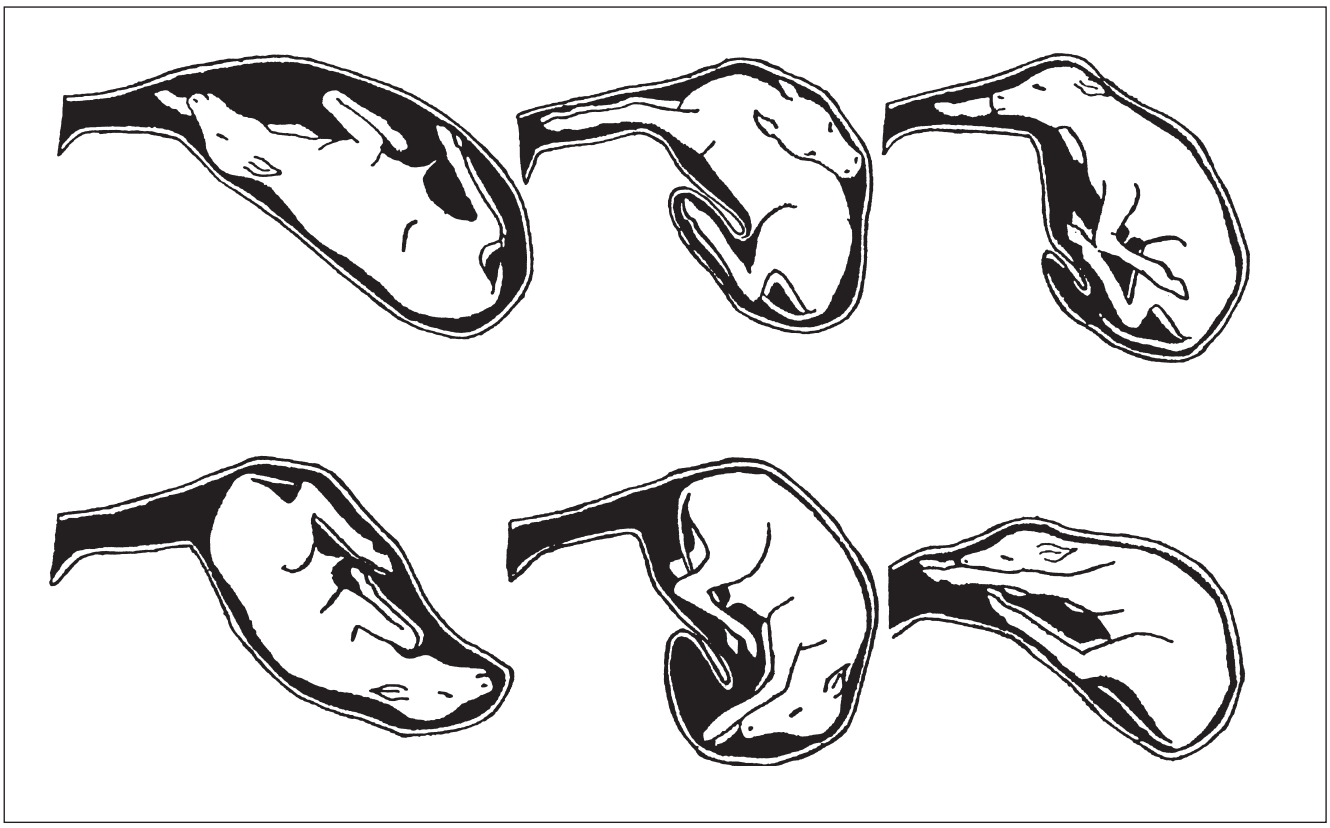


Figure 2.8
Abnormal birth positions.

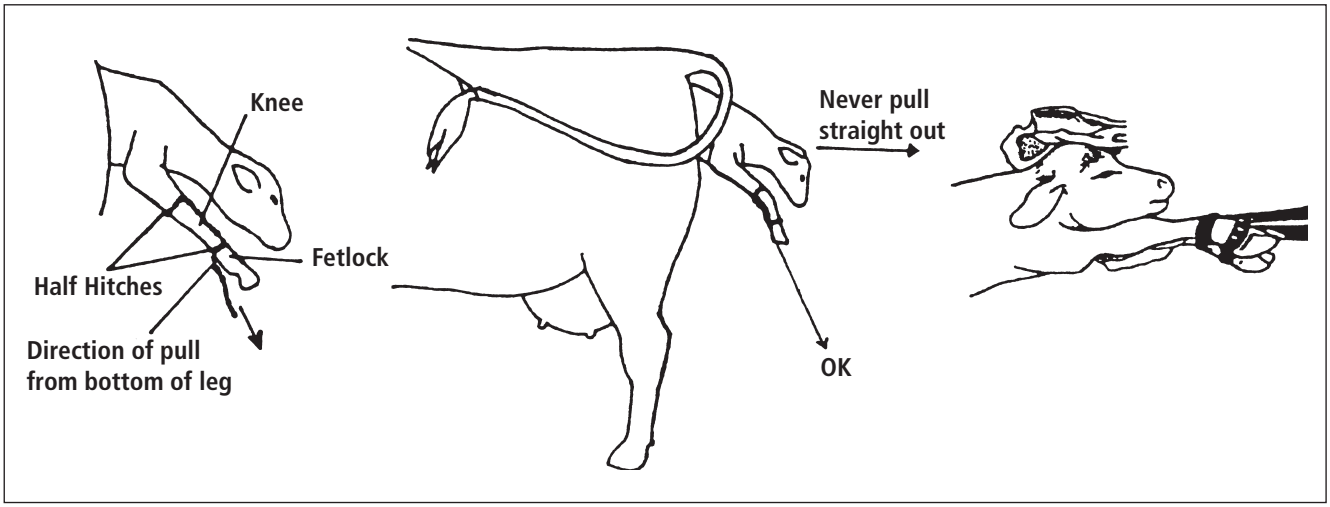


Figure 2.9
Pulling out a calf.

Infertility

There are many causes of infertility. They include:

- Poor nutrition.
- Age of cows and bulls.
- Diseases of either cows or bulls.
- Poor management: *e.g. Too many cows to one bull, rough or harsh handling, and putting the bull with cows at the wrong time.*

Breeding Systems

1. **Pure breeding**
   Pure breeding is the breeding of two animals of the same breed. There are different ways to do this:
   - Inbreeding is the mating of closely related family members: *e.g. Father x daughter.*
   - Linebreeding is the mating of distantly related family members who both have the same outstanding characteristics.
   - Outbreeding is the mating of a sire and dam of the same breed, but from unrelated families.

2. **Crossbreeding**
   This is the crossing of two different breeds of cattle, for example, a Hereford bull with a Jersey cow. Crossbreeding is done to try and improve the characteristics of the offspring.

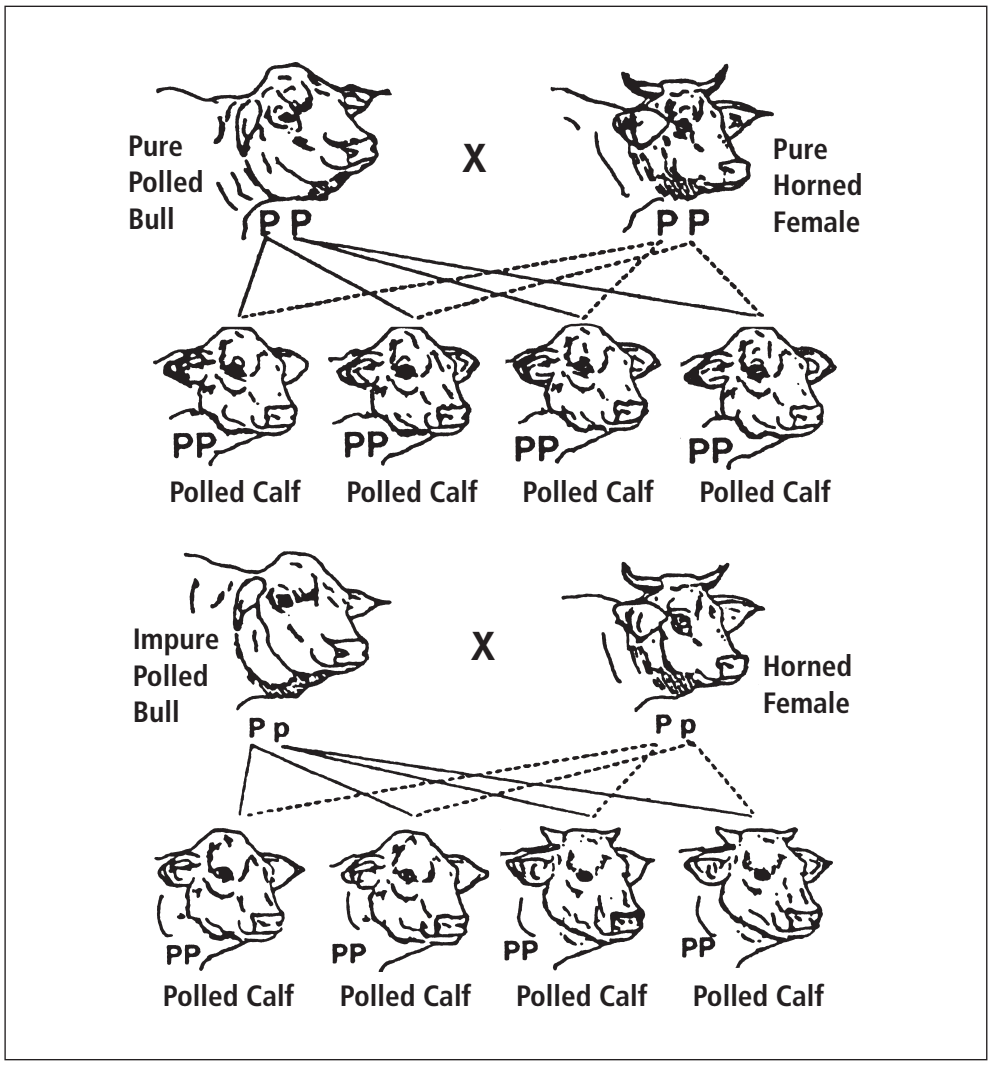


Figure 2.10
Crossbreeding.

Mating methods

The common mating methods for cattle include:

- Continuous mating. Farmers leave the bulls with the herd all year round. Therefore, calving happens throughout the year.
- Restricted mating. The bull is allowed to stay with the herd for 2–3 months each year.
- Artificial insemination (AI). This is when semen is collected (sperm in fluid) from the bull by artificial means and inserted into the uterus of a cow or heifer by using special equipment.

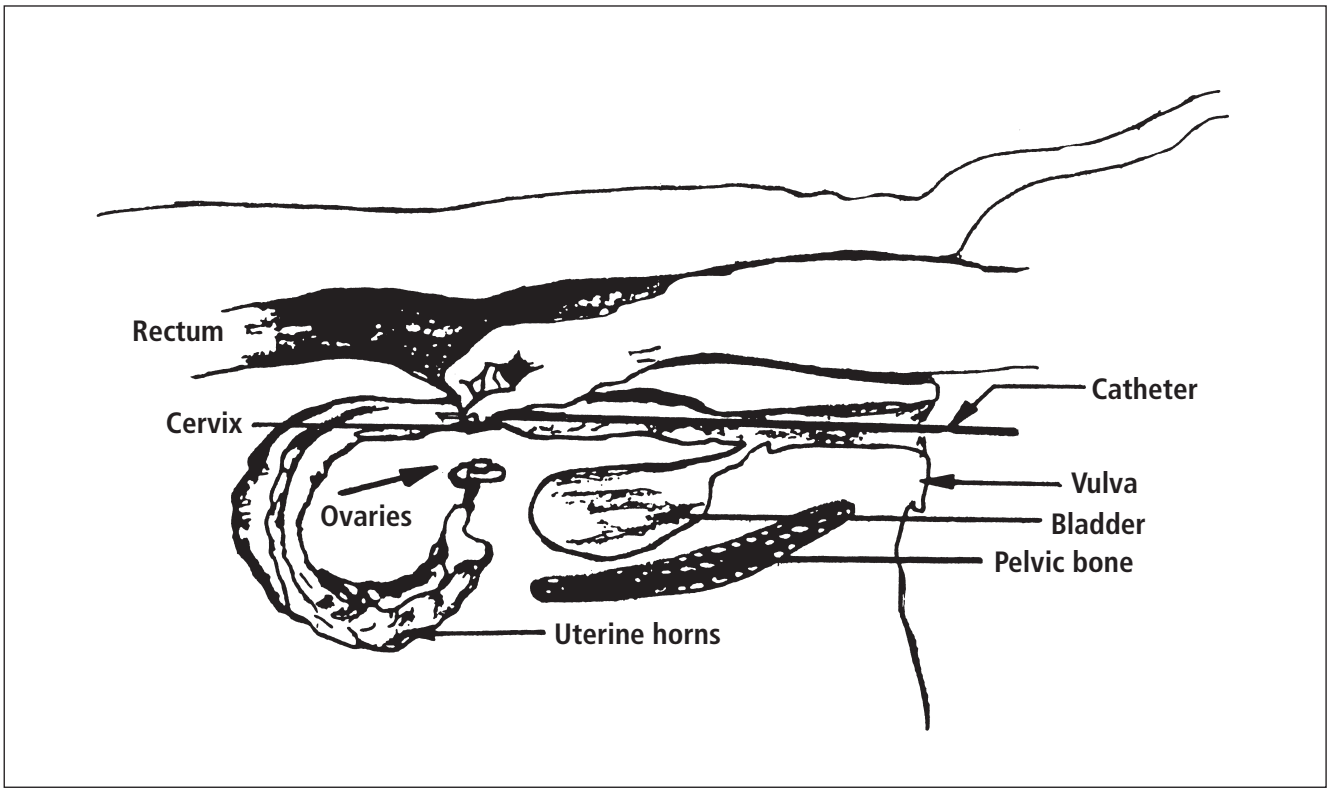


Figure 2.11
Artificial insemination.

Advantages and limitations of artificial insemination (AI)

Like many other new techniques, AI has both advantages and limitations. The table below gives the advantages and limitations of AI. Understanding these limitations, in particular, will help in successfully using AI.

Advantages	Limitations
◧ It increases the use of good quality bulls. Good productive traits can be introduced into the herd at a lower cost. ◧ You do not need to keep a bull. It means you have less trouble, less danger, and reduced cost. (Semen is readily available.) ◧ It overcomes some physical problems of some mating: *e.g. Bulls that have difficulty mounting cows*. ◧ It makes it possible to use a sire that is no longer alive. (Sperm can be frozen.) ◧ It reduces the likelihood of costly delays through using sterile sires. ◧ It ensures semen is free of diseases such as brucellosis and vibrio foetus. ◧ It makes it feasible to use more than one sire. ◧ It creates large families of animals. ◧ AI is done again, free of charge, if a cow does not get pregnant. ◧ It reduces calving intervals. ◧ It increases pride of ownership. ◧ It increases profit. ◧ It makes it possible to check the gene pool to avoid recessive genes that may be undesirable.	◧ It must follow physiological principals. ◧ It requires skilled technicians. ◧ Farmers cannot detect cows on heat. ◧ It requires money to start and operate an AI organisation. ◧ It may restrict the market for bulls. ◧ It may increase the spread of disease.

Activity 1 Types Of Beef Enterprises

Materials needed:
Coloured pens;
Newsprint.

Aim To understand the different types of beef enterprises in Samoa.

1. Divide into groups of three.
2. Each student is to select and read the information about one type of beef enterprise on page 12. Make sure you each choose a different one.
3. Discuss what you have read with the other members of your group.
4. As a group, select the method of raising cattle you think is best for rural farmers.
5. Make a chart showing the reasons why you selected your method of raising cattle.
6. As a team, using your chart, present your work to the rest of the class.

Activity 2 Characteristics Of Breeds

Materials needed:
Coloured pens;
Newsprint.

Aim To find out what cattle breeds are best suited to local conditions.

1. In groups of three, read and discuss the information on pages 14 and 15 about beef breeds.
2. Compare the characteristics of the different beef breeds and select a breed suitable for Samoa.
3. Give reasons for your selection.
4. As a team, present your work to the class.

Activity 3 Investigation — Breeding Systems

Materials needed:
Coloured pens;
Newsprint.

Aim To compare the different methods of breeding cattle.

1. In groups of three read and gather information on two of the breeding systems used for cattle.
2. Discuss what you have found and draw a chart of the two breeding systems you selected.
3. Present your information to the class for discussion.

Breeding System	Similarities	Differences

Activity 4 Investigation — Mating Methods

Materials needed:
Coloured pens;
Newsprint.

Aim To compare methods for mating cattle.

1. In groups of three, read and gather information on two mating methods in cattle.
2. Discuss and draw a chart of the two mating methods you selected.
3. Present this to the class for discussion.

Mating Methods	Similarities	Differences

Activity 5 Management Of Cattle

Materials needed:
Coloured pens;
Newsprint;
Notes on cattle management.

Aim To understand good management practices.

1. In the same groups, discuss and complete the table below. Look for more information in the textbooks provided by your teacher.
2. Describe each activity, and suggest management practices for each that can contribute to improved farm production. The first one is done for you.
3. Present your information to the class for discussion.

Management Activity	**Description**	**Management practices that can contribute to improved production**
Selection of cattle	Selecting cattle breeds to breed from	Select the breeds available that are best suited to local conditions
Oestrus		
Infertility		
Mating ratio		
Mating method		
Identifying pregnancy		
Identifying cattle close to calving		
Calving		

Review

Complete the following tasks in your exercise book:

1. List two beef breeds and two dairy breeds common in Samoa.
2. Describe two ways of finding out if cows are pregnant.
3. What mating method is most suitable for farmers with large commercial enterprises? Explain why you chose this method.
4. Describe the causes of infertility in cattle.
5. List the three types of cattle enterprises.
6. Explain why cattle production needs good management.

Unit 3: KEEPING CATTLE HEALTHY

About this unit
This unit looks at common problems in cattle production such as poor management, diseases, and internal and external parasites. It is important that cattle are kept healthy to achieve good rates of farm production. The symptoms, prevention, control and treatment of common diseases and parasites are explained to help students learn to take care of cattle.

Cattle Condition

Starvation is one major contributing factor to loss of production and selecting the best pasture crop for local conditions can help prevent this. On some farms, cattle do not have enough fresh water. Limited facilities for storing and pumping water can lead to water shortages during periods of dry weather. When cattle have injuries and wounds that are not treated flies can contaminate these wounds, leading to infection.

Two common bacterial diseases of beef cattle are brucellosis and tuberculosis. Poor management can introduce and spread disease or cause health problems in livestock: *e.g. Many diseases and parasites are spread by poor sanitation*.

Brucellosis

Brucellosis is a hidden disease, and one of the most serious and widespread diseases affecting the livestock industry. It is caused by a bacterium called *Brucella abortus*, and is a chronic, infectious disease. It also affects humans (leading to undulant fever).

Symptoms and signs of brucellosis
The symptoms of brucellosis in cattle are: abortion in the last trimester (third) of pregnancy, retained afterbirth, uterine infections, and infected bulls are usually sterile.

Infections of the udder result in a severe drop in milk production in an infected herd.

Treatment of brucellosis
There is no treatment. Infected animals should be destroyed.

Control and eradication of brucellosis can be achieved by blood testing animals and certifying brucellosis-free herds and areas. It is essential to find infected animals by testing and eliminate them from the herd.

Prevention of brucellosis
Buy replacement animals that are free of disease and that are from herds known to be free of the disease. Direct away, or fence off, drainage from infected areas. Avoid visiting infected farms, as bacteria may be brought home on shoes or clothing. Animals that are bought or sold should be isolated for 30 days and tested before adding to the herd.

Vaccination of calves with Strain 19 is effective in preventing brucellosis. Heifers should all be vaccinated at 2–10 months of age.

Tuberculosis (TB)

Tuberculosis is a chronic infectious disease. It affects all animals and humans. It is caused by a bacterium called *Mycobacterium tuberculosis*.

Symptoms and signs of tuberculosis
There may be weight loss, chronic cough and laboured breathing. Sometimes the udder becomes infected and, in chronic cases, it can become swollen. Other sites of infection are the genitals, central nervous system, and the digestive system. Humans can become infected with TB from cattle.

Treatment of tuberculosis
In animals there is no effective method of control. There is also no medical treatment that is effective with animals.

Prevention of tuberculosis
TB can be prevented in a herd by the removal and supervised slaughter of infected animals. Avoid housing cattle and pigs together with chickens. For humans, pasteurisation of milk and cream products provides protection from infection.

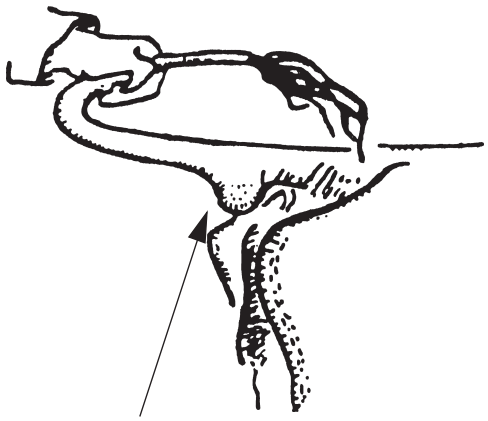


Figure 3.1
Testing for tuberculosis.

Parasites In Cattle

Internal parasites

Barber's pole worm (*Haemonchus placei*)
The barber's pole worm is a particular problem in tropical areas. It is a large stomach worm and the adults are up to 30 cm long. The females are identified as the barber's pole worm because their white ovaries are wrapped around their red, blood-filled intestine giving them their distinctive stripes.

Symptoms and signs
Heavy infection can cause animals to become unhealthy, listless, thin and weak. Symptoms include loss of appetite, weight loss and diarrhoea.

Brown stomach worm (*Ostertagia ostertagi*)
The brown stomach worm is the most common stomach worm to affect cattle production worldwide. Adults are reddish-brown and up to 1 cm in length.

Symptoms and signs
Heavily infested animals become unhealthy, listless, thin and weak showing a loss of appetite, weight loss and diarrhoea. The worms also reduce the immune response of cattle.

Treatment of stomach worms
Drench cattle regularly with Levicare or a mectrin-based drench such as Ivomec or Bouron.

Prevention and control
Rotate pasture. Segregate calves from mature animals. Avoid overstocking or overgrazing of pasture, because the infective larvae are mainly in the bottom inch of grass. Cross-graze cattle and horses. Keep feed stations and water supply clean.

Worms in the small intestine
Several round worms are found in the small intestine and colon including many species that are found in the stomach.

Symptoms and signs
Symptoms include loss of weight, failure to gain weight, anaemia and diarrhoea.

Treatment
Doses with copper sulfate, phenothiazine, thiabendazole, trichlorfon and tramisol before mating, after calving, and when grazing.

Prevention and control
Rotate pasture, segregate calves from mature animals and avoid overstocking or overgrazing of pasture, because the infective larvae are mainly on the bottom inch of grass. Cross-graze with cattle and horses, and keep feed stations and water supply clean.

External Parasites

Cattle tick
The most common external parasite is the cattle tick (*Boophilus microplus*).

Cattle ticks feed on blood and are capable of taking in many times their own weight. They cause disease by irritating the host animal so that it loses its appetite. They also transfer other diseases in their saliva, for example the protozoa disease, tick fever.

Symptoms and signs
Ticks reduce the vitality of cattle through constant irritation and loss of blood. Massive infestations may cause anaemia, weight loss, and even death. 'Head heaviness' is often associated with massive infestations of the ear.

Treatment
Insecticides that may be taken internally for tick control are: *amatraz*, *coumaphos* (Co RaL), *crotoxyphos* (Ciodrin), *fenvalerate* (Ectrin), *permethrin*, and *rabon*. Dipping with acaricide is also recommended.

Prevention and control
Dipping with acaricide or wipe-on insecticides can give effective control.

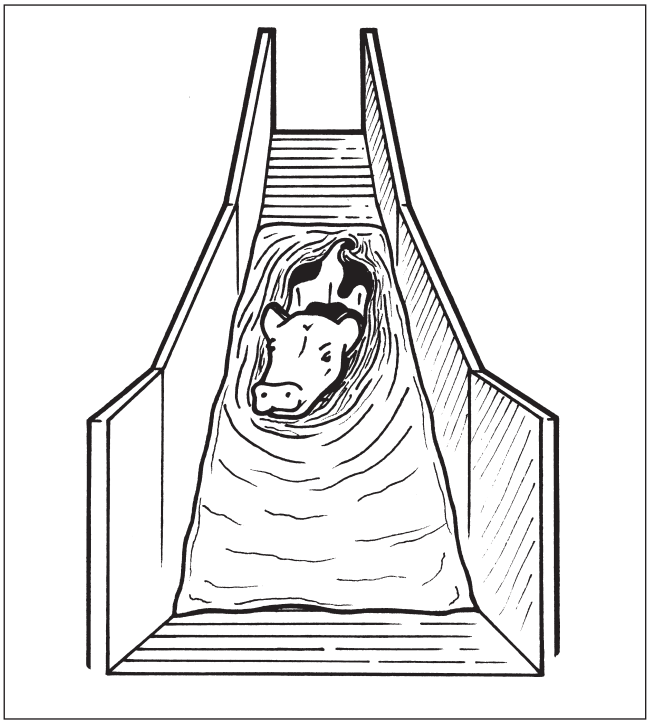


Figure 3.2
Dipping.

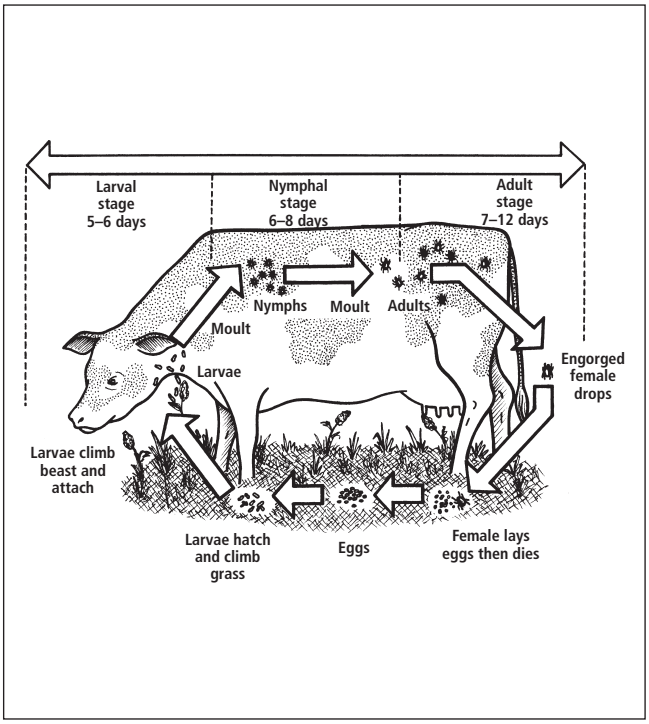


Figure 3.3
Life cycle of the cattle tick.

Poisonous Plants

Some weeds, if eaten, can make cattle very sick or even kill them. These poisonous weeds include lantana (Lantana camara L), Honolulu rose (Clerodendrum philippinum) and Pig weed (Portulaca oleracea L).

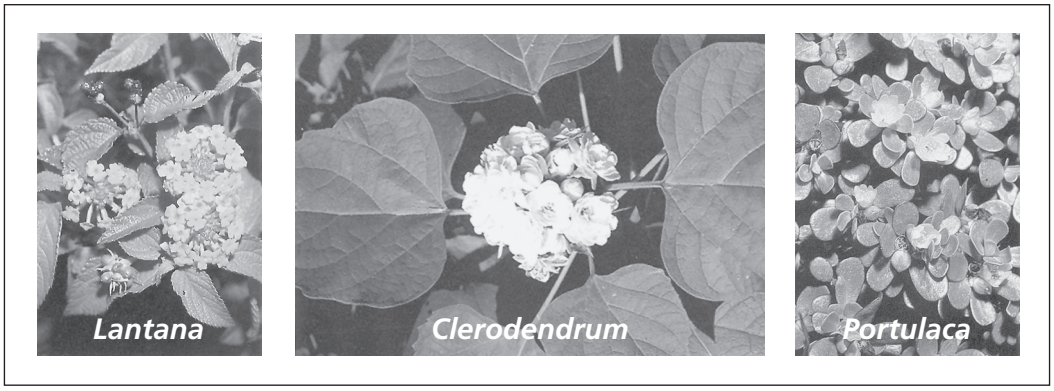


Figure 3.4
Poisonous weeds.

Activity 1 — Management Practices For Disease Prevention And Parasite Control

Materials needed:
Coloured pens;
Newsprint;
Sticky tape/drawing pins.

Aim To identify good management practices for disease prevention and parasite control.

1. Divide into pairs. Read the information on pages 25–29 and note down the key points. Explain what you read and the key points to your partner. Your partner may add points you missed. As a class, write the key points on the board. Copy these into your exercise book. Use the glossary to define words as they come up during the discussion.
2. In groups of five, read about the two main cattle diseases. Discuss the diseases and make a chart of their causes, symptoms and signs, and control and prevention measures. The teacher will select two groups to present their charts to the class.
3. In your groups, repeat the exercise for one parasite.

Activity 2 — Healthy And Unhealthy Cattle

Materials needed:
Coloured pens;
Newsprint;
Sticky tape/drawing pins;
Exercise book.

Aim To understand the main factors that contribute to healthy animals.

1. In groups study the figure below of two cattle.
2. Label them healthy or unhealthy and list the possible causes of their condition in a table.
3. In your exercise book list some ways the condition of the unhealthy cow can be improved.

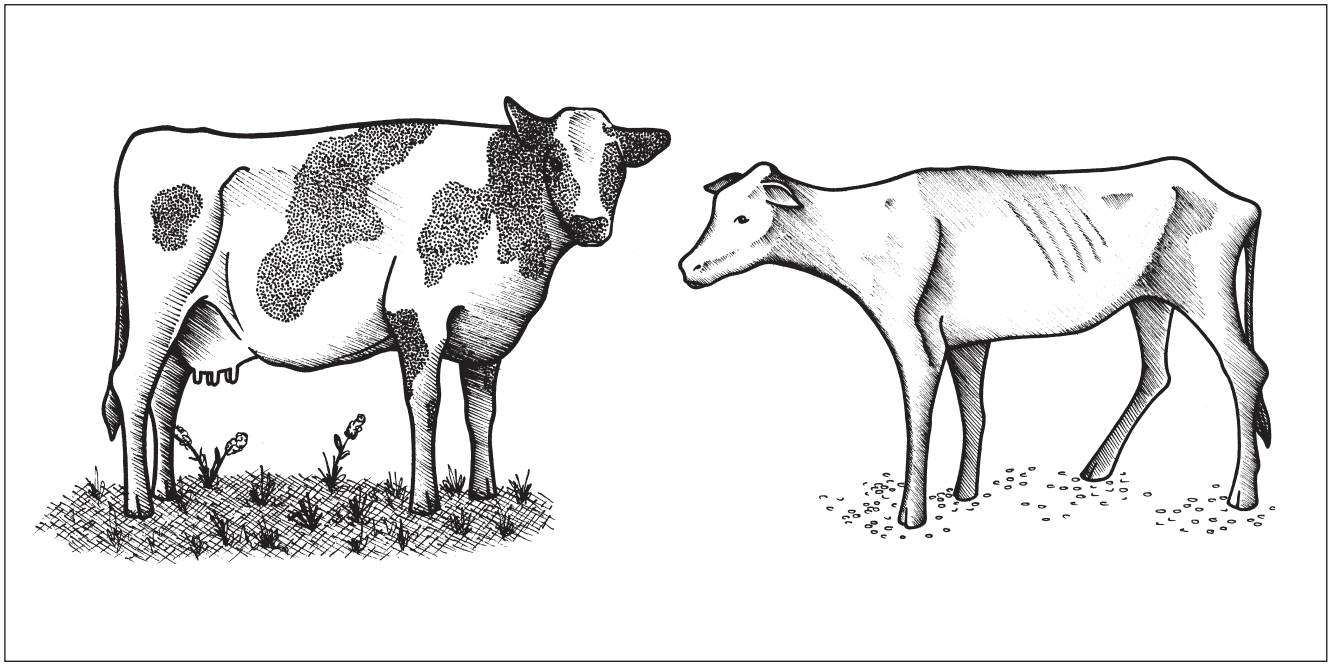


Figure 3.5
Healthy and unhealthy cattle.

Activity 3 Weed Collection

Materials needed:
Coloured pens;
Newspaper;
Cardboard;
Glue;
Scissors/cutter;
Weed plants.

Aim To identify plants that are harmful to cattle.

1. In pairs name some plants that are poisonous to cattle.
2. Collect leaf samples from two plants and bring them to class. Also, bring some used newspaper. Try and identify the plants. Your teacher will help you identify the plants that are poisonous to cattle.
3. Put the leaves between newspapers for a few days to dry. Change the newspapers if necessary.
4. When the leaves are dry, glue them on plain white paper and label them. Display them on the wall, or keep them together in a folder as a class collection.

Review

Complete the following tasks in your exercise book.

1. Name a common disease of cattle. Explain its symptoms, prevention, treatment and control.
2. Draw the life cycle of the cattle tick. When is the best time in its life cycle to control the cattle tick?
3. List some control measures for internal parasites.
4. Name three weeds poisonous to cattle. How can they be eradicated?
5. How does good health contribute to cattle production?
6. List some ways we can use to protect ourselves from getting infected with cattle diseases.

Unit 4: CATTLE FEED AND FEEDING CATTLE

About this unit

This unit covers the types of feed that are available locally and how they benefit cattle for growth, nutrition and health. After completing the activities students will have a better understanding of food types (pasture and concentrate feed), and the digestive system of cattle and how it works. The management of feeds and feeding is also discussed.

Feeding And Nutrition

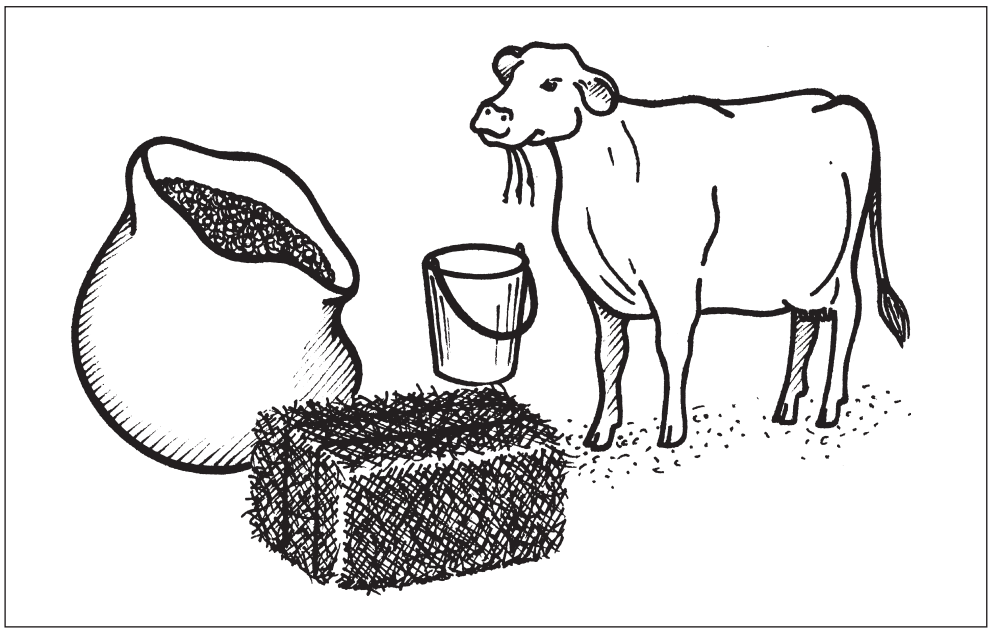


Figure 4.1
Feeding and Nutrition.

What is food?

Food is any nutritious substance that people or animals eat or drink, or that plants absorb, in order to maintain life and growth. It produces energy for vital body processes such as breathing, digestion, excretion and blood circulation. It is also used for milk production, repair of body tissue, and for reproduction.

Most cattle in this country get their food by grazing on plants. The plants build up complicated chemical materials in their tissue from carbon dioxide in the air, water and minerals in the soil. The energy needed for this process (photosynthesis) is provided by sunlight. The animal eats the plant tissue, breaks it down into its separate parts by the process of chewing and digestion, and absorbs it into its system (known as cellular respiration). Once absorbed, food provides energy and any excess is stored to provide reserves of energy for possible times of hunger, and the waste passes out in the form of faeces and urine. The faeces and urine contain minerals which become available to plants again, and so the cycle is completed.

Importance of providing adequate nutrition

Good quality pasture, which is a combination of grasses and legumes (both native and introduced), promotes growth and maintains the animals in good health.

Balanced nutrition is especially important for young calves. Good nutrition also enables cows to produce and rear healthy calves each year.

Nutrient requirements of cattle:

- Water is important for survival. It carries nutrients to individual cells of the body, and removes the waste products of cell activity. Animals' bodies are made up of 75% water.
- Fats are more concentrated sources of energy in the diet.
- Carbohydrates are the main source of energy. Most pasture grasses contain high levels of carbohydrates.
- Proteins provide amino acids important for the building and repair of body tissue.
- Vitamins play an important role in maintaining the health and vigour of animals.
- Minerals are essential for the growth and maintenance of healthy animals.
- Table salt is an important supplement required for fattening cattle. It supplies sodium which is important for the maintenance of the electrolyte balance of body fluids. Cattle need about 30–50g of salt each per day.

Classes Of Feed

There are two classes of supplementary feed:

- Roughage is relatively high in fibre and low in total digestible nutrient (TDN). Roughage is important for good digestion and can be found in grasses and legumes.
- Concentrates are relatively high in TDN but low in fibre. Concentrates may include cereal and grain and their by-products: *e.g. Corn, grain, rice bran, etc.*

  Concentrates also include high protein feeds: *e.g. Leucaena leaf meal, fish meal, copra meal, etc.*

Reasons for providing supplementary feed
There are three main reasons for providing good feed for farm animals:

- Maintenance. Cattle need food to stay alive and fit. Cattle are less likely to get sick if they get the food they need. If there is extra food available, the cattle will get bigger and the farmer will increase production.
- Production. Cattle need food in order to grow, or produce milk. If high levels of production are needed, then high quality food must be offered: *e.g. Fresh green grass*.
- Reproduction. A breeding animal needs both high quality and quantity of feed for successful reproduction.

Modern Practices For Feeding Cattle

In order to give enough food all year round, farmers must improve their pastures, sow new pastures, and fodder crops. They must store green fodder as silage, and hay, for feeding later, and give animals feed supplements such as concentrates, mineral supplements such as salt, calcium and phosphorus. They must also provide plenty of clean water.

Legumes are also an important crop for cattle feed because they are high in protein and add nitrogen to soil which leads to improved pasture growth. There is more information about legumes in Agricultural Science Year 9 Book 3 on page 58.

Grazing Management Systems

- **Continuous grazing**. This is a grazing system where animals graze the same piece of pasture all year round.
- **Rotational grazing**. This is a grazing system where one area of pasture is divided into a number of enclosures and animals are rotated through the different enclosures. It needs a higher level of management skill and is often an expensive option because of the need to have fences and water troughs in each enclosure.

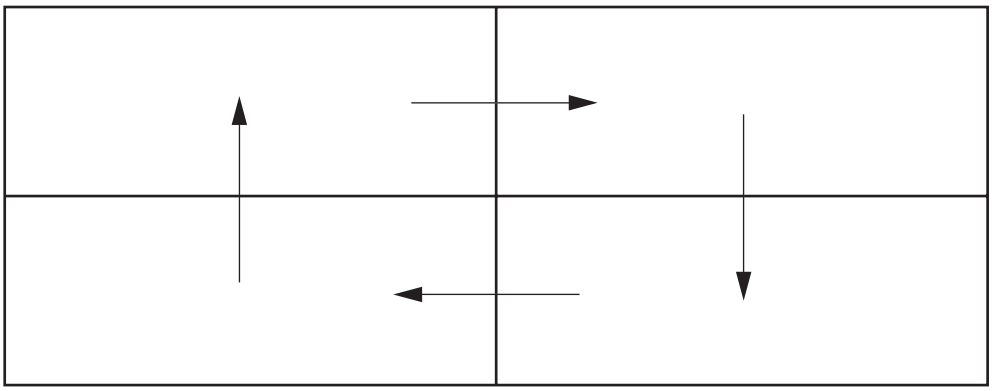


Figure 4.2
Rotational grazing.

- **Strip grazing**: The pasture is divided with electric fencing. Each strip is grazed for one day at a time.

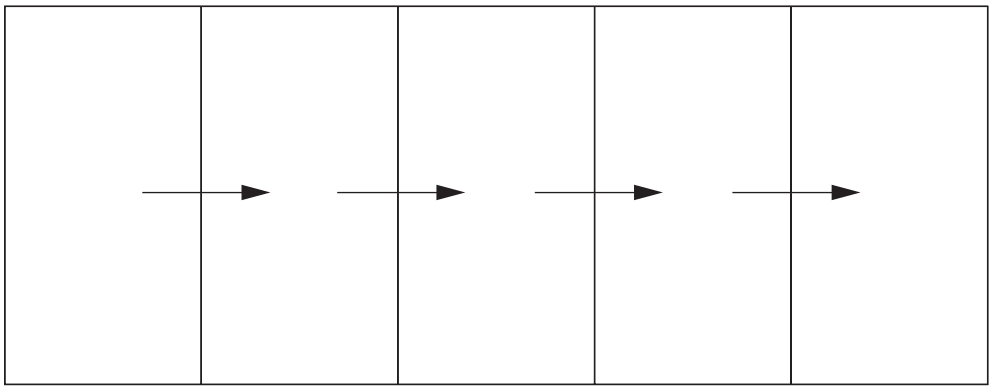


Figure 4.3
Strip grazing.

Annual Patterns Of Pasture Growth

The graph below shows the general 'growth curve' of pasture in any year. Pasture grows well in the wet season and growth is poor during the dry season. Because pasture is the main source of cattle feed in Samoa, this is important information for cattle farmers.

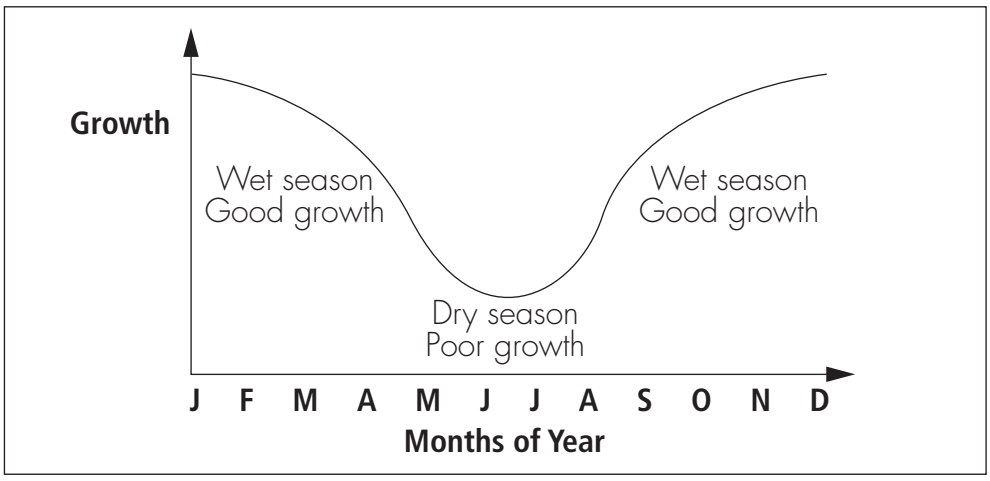


Figure 4.4
Graph of pasture growth.

Calculation Of Digestibility

Animal production is determined by two factors:

- Voluntary intake. This refers to how much food an animal voluntarily eats.
- Digestibility. This is the percentage of voluntary intake of dry matter (DM) digested in the body of an animal.

$$\text{Digestibility} = \frac{\text{DM intake} - \text{DM output}}{\text{DM intake}} \times 100$$

Feeding young calves

If possible, always feed calves with their mother's milk. This is because a calf's stomach, in its first week of life, is not fully developed and the best food for a young calf is cow's milk. A two-month-old calf fed with its mother's milk receives 4–6 litres of milk each day. However, at three weeks of age, a calf can be given a little green grass and at three months, when the calf can digest grass, it can be fully weaned.

Supplementary feed at weaning

Cereals, oil cake and grain meal are good supplementary feed for calves at weaning.

The Digestive System

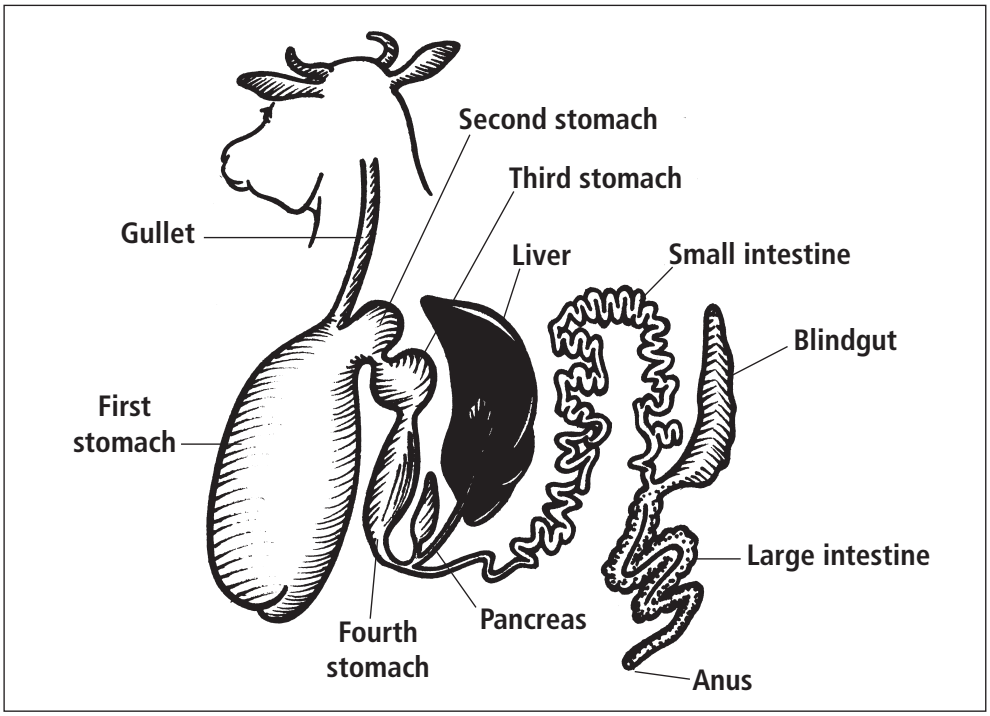


Figure 4.5
The digestive system of cattle.

Ruminants

Cattle, sheep and goats are special kinds of animals called ruminants. Ruminants have four stomachs and chew their food twice. The food first goes into a large bag called the first stomach, or rumen. The food is stored in the rumen while the cattle are eating. Later, when they stop eating they may lie down in the shade to rest. Then they bring up little bits of food into their mouths. They chew this food again very well. This is called 'chewing the cud'. After chewing the food a second time they swallow it. Soon, the animal will have chewed up all the food in the rumen a second time.

The rumen and other stomachs

In the rumen there are many thousands of small organisms called microbes. We cannot see these microbes with our eyes because they are too small, but they help to soften the food in the rumen. When the food leaves the rumen, it goes through the second stomach, the third stomach and into the fourth stomach. In the fourth stomach the food is mixed with a strong juice produced in the fourth stomach, which further softens the food and kills the microbes. When the food leaves the fourth stomach it goes into the long, thin tube called the small intestine. At this point, some extra juices come into the food from the pancreas and the liver.

The small intestine

While the food passes down the small intestine some of it is turned into a liquid. Food which is turned into a liquid is called digested food. This digested food goes through the wall of the small intestine and into the blood vessels that surround the intestine.

Some of the food which is too hard and has not been fully digested goes right through the small intestine and into the large intestine. It says there before passing out of the anus as dung. The dung acts as a manure to improve pasture.

Activity 1 Model Of The Digestive System

Materials needed:
Coloured pens;
Newspaper;
Cardboard;
Glue;
Scissors/cutter;
Plastiscine.

Aim To develop a model for the digestive system of cattle.

1. Divide into groups of three.
2. Read the information and discuss the digestive system of cattle — its parts, and their functions.
3. Use paper or other materials to develop a model of the digestive system of cattle.
4. Label the parts and briefly explain their main functions.
5. Have a class display of all the models.

Activity 2 — Short Investigation — The Nutritive Value Of Feeds

Materials needed:
Pen;
Information on different feeds;
Exercise book.

Aim To compare types of cattle feed.

1. In your same groups do a short investigation on the nutritive value of a variety of grass: *e.g. Batiki* and a cattle feed: *e.g. Fish meal*. Use textbooks, research reports, the University of the South Pacific library, the Internet and Ministry of Agriculture publications. Your teacher will make sure the class covers a wide range of options.
2. Draw a table similar to the one below and compare the nutritive value of the two feed options.
3. Select the better feed. Give reasons for your choice.

Nutrient	Grass	Cattle Feed (Supplementary feed)
Protein		
Carbohydrates		

Activity 3 — Growth Pattern Of Pasture

Materials needed:
Coloured pens;
Newsprint;
Ruler.

Aim To understand the yearly cycle of cattle production.

1. In groups study the information about the annual pattern of pasture growth on page 35.
2. Draw a similar graph for last year. Your teacher will get the information you need from the meteorology section of the Ministry of Agriculture, Fisheries, Forests and Meteorology.
3. Looking at the pattern of pasture growth, discuss and determine the best months for calving, weaning and supplying concentrated feed.
4. Give reasons for your answers.

Review

1. Why is the digestive system important?
2. Describe the main function of the digestive system.
3. Name some grasses, legumes and concentrated feeds for cattle that are available locally.
4. Why are legumes and concentrated feeds important to cattle farmers?
5. Why is clean water important for cattle health?

Unit 5: MANAGING CATTLE

About this unit

This is a practical unit and students will have the opportunity to visit a cattle farm and practise some common management activities that are carried out there. These may include weed control, pasture planting, yarding, dehorning, branding and ear tagging stock, and fencing. They will also watch and assist in slaughtering and dressing cattle for meat.

Management practices for breeder cows and heifers

A good farmer will know when a cow has been successfully mated, and by adding 280–285 days, will know when the calf is due. Mated heifers are the most important animals in any herd and need more attention than old cows.

Females should be mated and calve in a state of good health (when pasture growth is good). Make sure females are strong, fit and well-fed during pregnancy. During the last week of pregnancy the cow should be removed from the herd to a small well-grassed paddock with adequate water supply. Carry out daily inspection or, even better, twice-daily inspection.

Cows and heifers that are in calf should not be handled roughly. Avoid selling an in-calf cow. If possible, sell the cow after, or at, weaning. First-calf heifers should be watched at calving time, as they will often need some assistance.

Older cows that have had trouble calving should be culled from the herd.

Management practices for breeding bulls

Bulls can be dangerous and should be treated with respect. Cull any bull that becomes difficult to handle. If you are raising your own heifers, change your bull every 3–4 years. If you are buying heifers, keep your bull for 5–6 years then sell him while he is big and meaty so that the income will pay for a new bull. Brahman-type bulls can improve your herds adaptability to local conditions and resistance to tick, but special management is required.

Proper feeding with good grass and water are essential for successful bull management.

Management practices for calves and weaners

Castrate male calves when they are 4–12 weeks of age while they are easy to handle. Wean your calves at 6–8 months of age. It is important that there is plenty of grass available for weaned calves.

Sell weaners before they reach 200 kg (live weight) to save time, labour, feed and money. At that stage they are able to cope with a change of environment.

Dehorn or tip calves, if horns are a problem. This should be done as early as possible, around 10 days of age.

Castration

Castration is carried out to control breeding, make animals docile, and to produce better quality beef. Commonly used methods of castration are: castrator rings, knife, burdizzo pincers, injectable chemical castration, and removal of the lower end of the scrotum.

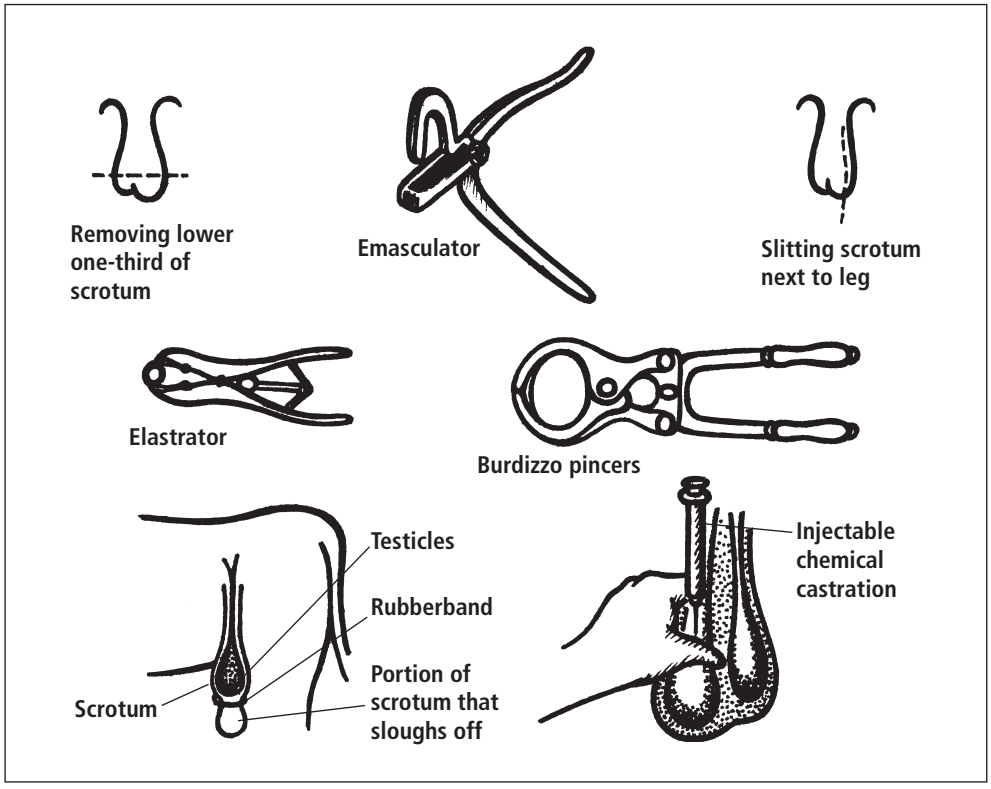


Figure 5.1
Equipment and method used for castration.

Dehorning

Dehorning is carried out to prevent human and animal injuries, make handling easier, and reduce the number of bruised carcasses. The common methods of dehorning are: caustic soda stick, saws, clippers or wire, the dehorning spoon or tube, and the hot iron. There are some breeds called 'polled' cattle that do not grow horns.

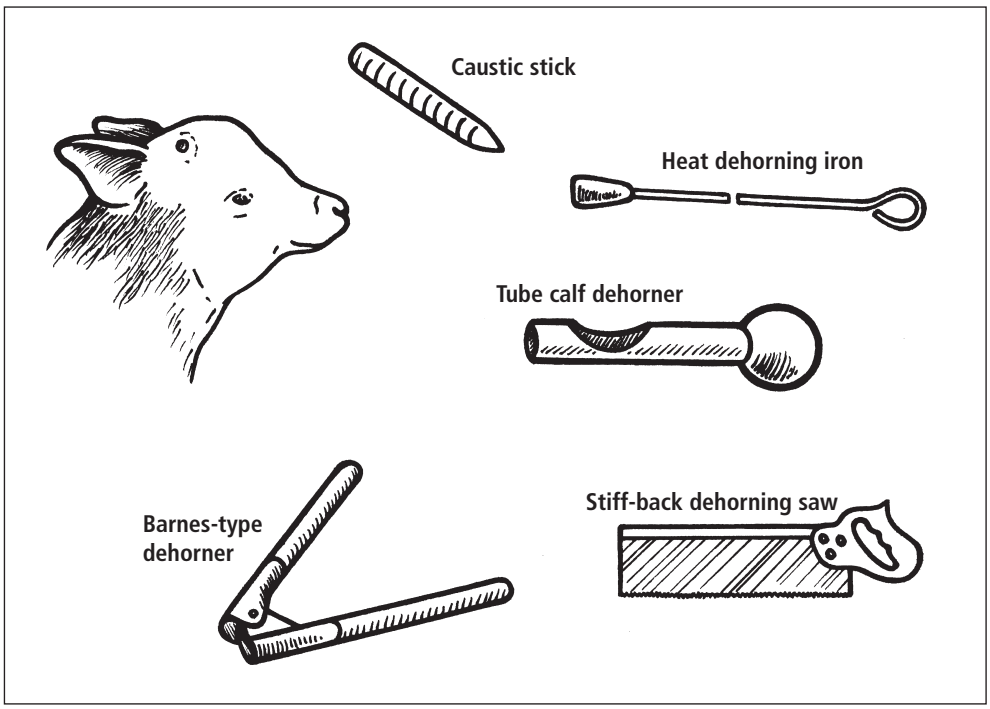


Figure 5.2
Equipment used for dehorning.

Animal Identification

The common identification methods used by farmers are:

- Hide brands using a hot iron, freeze branding, or branding fluid.
- Ear tagging using plastic or metal ear tags, or buttons.
- Ear notching.
- Tattooing.

Drenching

To maintain healthy stock and herds, cattle can be treated with medicines to cure or prevent diseases and parasites. Sometimes this medicine needs to be taken orally and is forced down the animal's throat using a special hand-held 'gun'. This process is called drenching.

Stocking Rate

Good pasture management depends on having the right number of cattle for the area of land and pasture available. This means the cattle will have enough to eat and the owner will make a profit.

Advantages of correct stocking

Different cattle eat different amounts of grass and as cattle grow, or have calves, they need more grass. For example, if your farm is correctly stocked with five cows, five calves and a bull then if these calves are not sold the farm will soon be overstocked as it will have to support five cows, five weaners and a bull. Five weaners eat about the same amount of grass as 1–2 cows.

Also, different land has different stocking rates. This means an area of land will be able to support a certain number of cattle depending on its topography, vegetation and access to clean water.

Problems of overstocking

Overstocking (having too many animals on the pasture) results in:

- Poor animals of little value which fail to grow.
- Cows that are unable to have calves because of poor nutrition.
- Cattle can become restless. If so, they are likely to break out and get into gardens, be hunted and killed, or become wild.

If there is a problem of overstocking it is important to take steps to prevent long-term damage to stock and pasture. You could:

- Graze cattle off the farm, but only under constant supervision. This can be used as a temporary measure.
- Cull some steers or old cows.

Calculating stocking rates

Animals of different sizes eat different amounts of grass. Therefore, it is not very useful to express stocking rate as 'the number of animals per hectare' or 'the number of animals per acre'. Instead, we use a standard measure: the animal unit (AU). Stocking rate is the number of animal units grazing a given area. It is expressed as 'animal units per hectare' (AU/ha) or 'animals units per acre' (AU/acre).

The standard measure, in animal units, of different animals are given below:

Calf 1–6 months	=	0.25 AU
Weaners, 8 months (105 kg)	=	0.4 AU
6 months–1 year (150–200 kg)	=	0.5 AU
Heifer 1–2 years	=	0.75 AU
Mature steer (400 kg)	=	1.0 AU
Dry, unmated cow	=	1.0 AU
Dry pregnant cow	=	1.2 AU
Bull	=	1.5–2.0 AU
Cow with young calf	=	1.8 AU

We can use the AU to calculate stocking rates as in the following example where the herd described grazes a 9.9 ha pasture:

1 bull at 1.5 AU	=	1.5
2 cows with calves at 1.8 AU	=	3.6
2 dry cows at 1.2 AU	=	2.4
1 heifer at 1.0 AU	=	1.0
1 steer at 1.0 AU	=	1.0
Total animal units	=	9.5
Area being grazed	=	9.9 ha
Stocking rate: 9.5 AU/9.9 ha	=	Approximately 1 AU/ha (0.4AU/acre)

It is important that farmers work with a livestock officer to calculate the right stocking rate for their farm.

Record Keeping

Records are any set of information that are collected and stored for decision-making and planning purposes. Records should always be kept in a simple and easily accessible format.

They should be easy to work with and easily transferred to other records.

Records are useful for:

- Making decisions about future farm operations.
- Evaluating the performance of the farm over a given period of time.
- Providing basic information for planning and budgeting.
- Determining resource requirements, commitments and/or limitations.
- Reviewing the financial status of the farm at a given time.
- Determining farm gains and losses.
- Making predictions about future events.
- Evaluating self-achievement.
- Research purposes.

Types of farm records

The three main types of farm records are:

- Farm inventory records. These list the equipment and animals (assets) owned by the farmer.
- Farm production records. These refer to the actual resources available (input) and production achieved (output). This includes livestock production, crop yield and physical inputs like labour and fertiliser.
- Financial records. These refer to all farm accounts, including costs, returns, income, and financial and production record books.

Establishing A Cattle Project

Before establishing a new cattle farm, farmers must plan carefully and make good decisions. They must consider factors such as whether they have enough land, enough clean water, good quality pasture, good fencing, cattle know-how (knowledge and skills), and whether the location is suitable.

Selecting a site

One important factor in establishing a cattle project is the selection of a suitable site. Some factors livestock farmers must be aware of when selecting a site are:

- The system of ownership of the land, especially customary land.
- Topography. Is it too hilly?
- Access to roads.
- Access to wharf and markets.
- Is it is close to home?
- Is the pasture good enough?

Clearing

If you select primary bush land to establish a project, the land must first be cleared to create the right conditions for your venture to have a successful start. When you establish new pasture it is important to select the right grasses for the local conditions and to carefully prepare the ground for planting.

Fencing and building work

The next thing to consider is fencing the area into paddocks and building stockyards. Sometimes there are natural boundaries, but, if fences are needed, make sure they are strong. The standard 'three barb' fence uses standard posts and strainer posts where necessary, at corners and gateways.

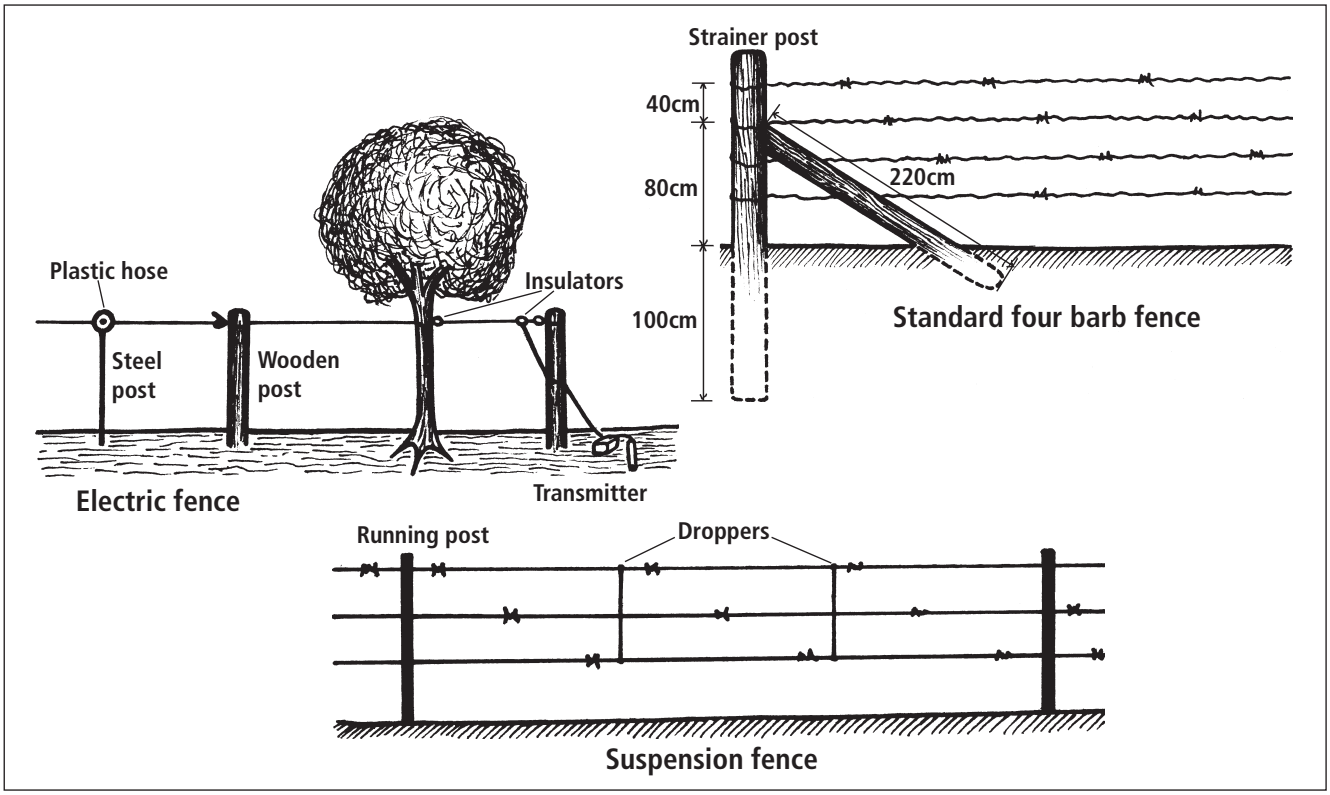


Figure 5.3
Types of fences and posts.

Water supply
It is important to establish a good year-round supply of clean water and to provide troughs in each paddock.

Before any cattle arrive make sure that the following things have all been organised:

- Enough good quality pasture for cattle to feed on.
- Good supply of water for cattle at all times in each paddock.
- Fences are properly built and firm. This is important to control stock and access to pasture.
- Shady places in the paddocks for stock to get out of the hot sun.

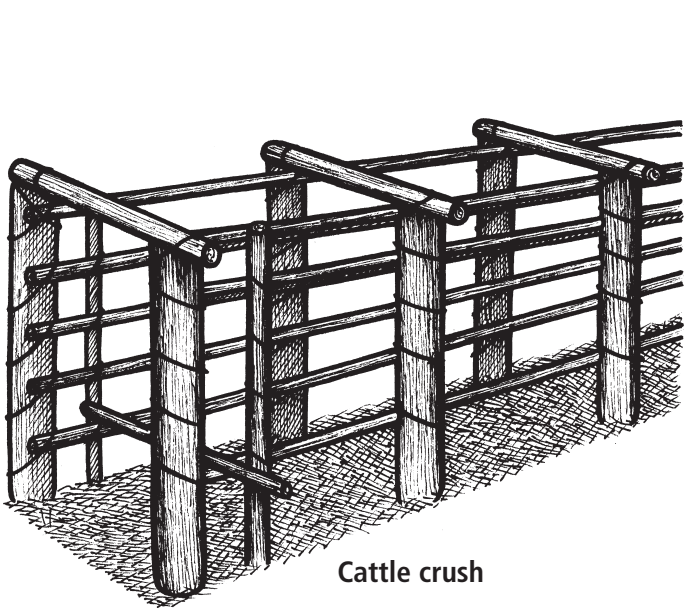
Reasons For Building Cattle Yards

There are several reasons why cattle yards are needed:

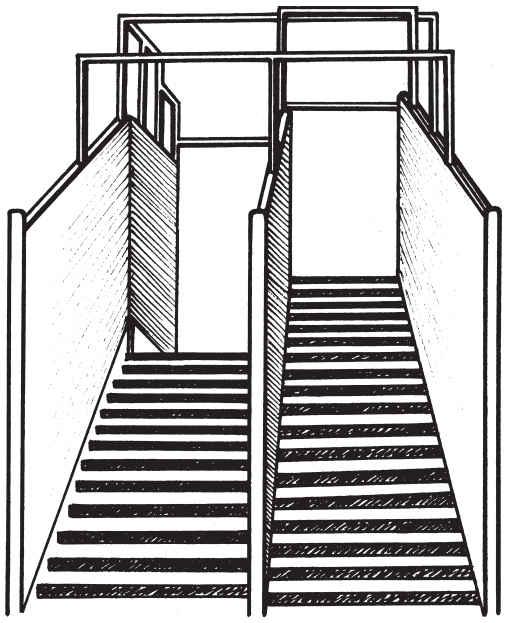
- They provide a safe and efficient way of handling, inspecting, drafting, weaning, loading and unloading stock.
- They help in holding cattle still for ear tagging, branding, castration, dehorning, pregnancy testing, drenching, treatment of wounds, and treatment of external parasites.
- They keep sick, diseased or injured animals away from the main herd where they can be easily treated and are able to rest undisturbed.

Parts of a cattle yard:

- Receiving yard.
- Forcing yard.
- The crush.
- Loading ramp.
- Holding yard.
- Drafting gates.
- Slip rails and bale gates.
- Yard gates.



Cattle crush



Loading ramp

Figure 5.4
Cattle crush and loading ramp.

Slaughtering And Preparing A Carcass

Pre-slaughtering treatment
Before an animal is to be slaughtered provide enough water for the animal. (Feeding is not necessary for a period of up to 24 hours.)

Slaughtering

To slaughter an animal follow these steps:

- **Stunning**. Animals are 'stunned' by a device known as a 'captive bolt' so that they can be killed humanely.
- **Sticking**. The stunned body is then lifted up so that the jugular veins and carotid arteries can be cut with a sharp knife (known as 'sticking'). Then the blood is drained from the carcass.
- **Skinning**. The hide, feet, and head are removed.
- **Gutting**. The gut is removed without breaking the stomach or the intestines. After the gut, head, legs and other offal are removed the animal carcass is normally 50–55 per cent of its live weight.
- **Inspection**. The carcass and viscera are inspected by a meat inspector from the Ministry of Agriculture to determine their suitability for human consumption.
- **Halving**. The carcass is halved by removing the tail and splitting the backbone with a saw.
- **Cooling and quartering**. The carcass is washed, cooled, and cut between the 12th and 13th ribs to expose the loin 'eye'.

Factors affecting meat quality

Tenderness, meat colour, fat colour and meat flavour are the main factors that affect meat quality. The most important factor affecting meat quality is tenderness. Most consumers prefer bright red meat, but most of the flavour in meat is due to the fat content, and in healthy cattle the fat is white or yellow.

Carcass by-products

The following by-products are useful for different purposes:

- Hide — for leather products.
- Bones — for protein supplement.
- Offal and condemned meat — for meat meal.
- Blood — for livestock food and fertiliser.
- Hooves and horns — for glue.
- Contents of the rumen — for fertiliser.

Practical Activities — Field Trips

For Activities 1–3 you will go out to a farm, see demonstrations, and carry out instructions given by the farmer, your teacher or a livestock officer. It is important that you wear suitable work clothes and obey all instructions.

Activity 1 Yarding, Roping, Castration And Branding Or Ear Tagging

Materials needed:
Rope;
Cattle;
Stockyard;
Castrating tools;
Branding tools;
Ear-tagging tools.

Aim To learn about handling stock.

1. As a class, following instructions from the teacher or farmer, slowly direct and move cattle from a paddock to the stockyard. Close the gate of the paddock and stockyard after all cattle have gone into the stockyard. Do not tease or frighten the cattle.
2. Watch the farmer rope and restrain a calf.
3. Watch the farmer, livestock officer or teacher demonstrate castration, dehorning and branding or ear tagging on the calf. You may have the opportunity to practise this following instructions from your teacher.
4. Write a short report, including figures, on the demonstration you watched or took part in. Give reasons why farmers carry out these activities.
5. Discuss with the class what you observed, learnt and practised. Suggest any improvements to the way things were done.

Activity 2 Fencing

Materials needed:
Fencing wire;
Fencing tools;
Posts;
Long blade spade.

Aim To learn how to build a fence.

1. In pairs assist the teacher or farmer to measure a fence line, dig holes and put in posts.
2. In pairs assist the teacher or farmer to put up or fix an electric or barbwire fence.
3. Write a report, including figures, on the practical you took part in.
4. Give reasons why farmers carry out this activity.
5. Discuss with the class what you observed, learnt and practised. Suggest any improvements to the way things were done.

Activity 3 Pasture Management

Materials needed:
Spade;
Digging fork;
Bush knife;
Pasture grasses.

Aim To practise good pasture management.

1. Remove all weeds from the paddock by pulling out, using knives, digging fork or spade. Make sure you get all the roots.
2. Dig out and transplant pasture: *e.g. Batiki,* in the paddock.
3. Give reasons for carrying out this activity.
4. Discuss with the class what you observed, learnt and practised. Suggest any improvements to the way things were done.

Activity 4 Investigation — Slaughtering And Dressing Of Cattle

Materials needed:
Coloured pens;
Newsprint;
Cardboard;
Glue;
Scissors/cutter.

Aim To compare traditional Samoan and western methods of slaughtering cattle.

1. In groups of three investigate how cattle are slaughtered and dressed for human consumption using the traditional Samoan and western methods.
2. Discuss each method and draw and label a flow chart of the slaughtering and dressing processes.
3. Compare the two methods using a table like the one below.
4. Discuss and select a method that is humane and safe for human consumption. Give reasons for your choice.

Steps of the process	Western method	Traditional method
Stunning		
Sticking		
Skinning		
Gutting		
Inspection		
Halving		
Cooling and quartering		

Activity 5 Farm Visit

Materials needed:
Pencils;
Notebook;
Tape recorder;
Camera.

In this activity you will visit a cattle farm to see how the farmer is managing the cattle. Before you go, prepare questions on cattle management, breeds, nutrition and animal health, to ask the farmer.

Aim To meet a farmer and find out about his farming practices.

1. Divide into five groups. In your groups design questions on one of the topics: breeds, breeding, nutrition, animal health and management. Each group is to ask questions on one topic. Use the 5 W's and an H: When? Where? Why? What? Who? and How?
2. Visit the school cattle farm or a nearby farm.
3. Listen to the farm manager talk about how the farm is managed.
4. Ask your questions and record the farmer's answers.
5. Write a short report on how the farmer is managing the farm.

Review

1. Describe two methods of castration.
2. Describe two methods of stock identification.
3. List the steps in slaughtering and dressing cattle.
4. Explain why drenching is carried out in cattle.
5. Why is it important to keep records in cattle production?
6. Why should cattle be treated with respect?
7. Why should weeds be removed from paddocks?
8. Why are cattle dehorned?

Unit 6: THE PRODUCTION FUNCTION

About this unit

This unit emphasises some of the basic principles and limitations of economic theory in farm production. It focuses on three main concepts:

- Economic theory of farm production.
- The production function.
- Cost functions.

Economic theory of farm production

The economic theory of production described here applies to all types of farming (not just cattle) and is based on the concept of marginalism. Marginalism refers to incremental or additional changes in either revenues or costs as the farm manager or farmer makes or plans changes in farm production. Any marginal change is worked out by finding the difference between the original value and the new value of farm production, resulting from the change.

Economic decisions are then based on changes in costs and revenue. Farmers do this in order to maximise profits. Hence, the farmer may carry out a farm plan if the marginal change in revenue (income) is greater than the marginal costs (of production).

Types of production relationships in agriculture

Farm production data involving crops, livestock and resources generated by farmers, agronomists, soil scientists, economists, animal scientists and engineers may be used to build relationships (functions) between outputs (production) and inputs (costs of production). The main relationships are:

- Input-output relationship: *e.g. Fertiliser to produce taro.*
- Input-input relationship between two inputs: *e.g. Land and labour to produce taro.*
- Output-output relationship. In this case, the farmer is producing more than one product, for example, he may be producing taro and ta'amu on a fixed piece of land.

In this unit, however, we will only be looking at the input-out relationship.

Input-output Relationship

The input-output relationship is sometimes called a 'production function'.

A farm production function is a table or mathematical equation showing the maximum output that can be produced from given inputs: *e.g. Farm technology, climate and soil condition*. It, therefore, relates the farm production to the inputs used in the production process.

Factors the farmer cannot control

The production of a farm commodity is largely a biological process and, therefore, depends on factors within and outside the farmer's control. For example, the production of beans depends on inputs such as land, labour, and capital inputs such as seedlings and fertiliser. Other factors such as available soil nutrients, soil moisture, soil structure, air quality, plant spacing and intensity of light also have an effect. The use of inputs such as fertiliser, land and seedlings can be controlled by the farmer since the farmer can use more or less of these resources, within the limits of availability. However, inputs such as temperature and rainfall cannot always be controlled by the farmer. It is the presence of these factors that the farmer cannot control that makes farming a particularly risky venture compared to other occupations.

Production function analysis

Figure 6.1 presents an example of a production function analysis for beans with one variable (controllable input) — fertiliser. (Note that the same basic principles may be applied to a production function with several variables.)

The total physical product (TPP) is the total output of beans at given rates of fertiliser application.

The average physical product (APP) is calculated by dividing the total physical product by the fertiliser level. Thus, the average physical product at 100 kg/ha of fertiliser is 3.50 (see Figure 6.1).

$$\text{APP} = \frac{\text{Total physical product}}{\text{Fertiliser level}}$$

The marginal physical product (MPP) is the additional (incremental change in) TPP from using one more kilogram of fertiliser. MPP is calculated as follows:

$$\text{MPP} = \frac{\text{Change in total physical product}}{\text{Change in input (fertiliser rate)}}$$

(1) **Fertiliser levels (in kg/ha)**	(2) **Total physical output TPP (in kg/ha)**	(3) $\frac{\text{TPP}}{\text{Fertiliser level}}$ **APP (in kg/ha)**	(4) **MPP (in kg/ha)**
0	200	-	-
20	250	$\frac{250}{20} = 12.50$	$\frac{250-200}{20-0} = \frac{50}{20} = 2.50$
40	290	$\frac{290}{40} = 7.25$	$\frac{290-250}{40-20} = \frac{40}{20} = 2.00$
60	320	5.33	1.50
80	340	4.25	1.00
100	350	3.50	0.50
120	355	2.96	0.25

Figure 6.1
Production function of beans.

Notes on Figure 6.1:

Notice that as more fertiliser is applied, the MPP of beans increases, but at a decreasing rate. When the first 20 kg/ha of fertiliser is added, the additional or marginal total production increases by 2.5 kg per hectare. When the amount of fertiliser is increased to 40 kg/ha, the additional production only increases by 2 kg per hectare. This phenomenon, which is common in farm production, is known as 'the Law of Diminishing Marginal Returns' or 'the Law of Diminishing Returns' for short.

The production function

Economic theory presents a generalised form of the production function with three stages.

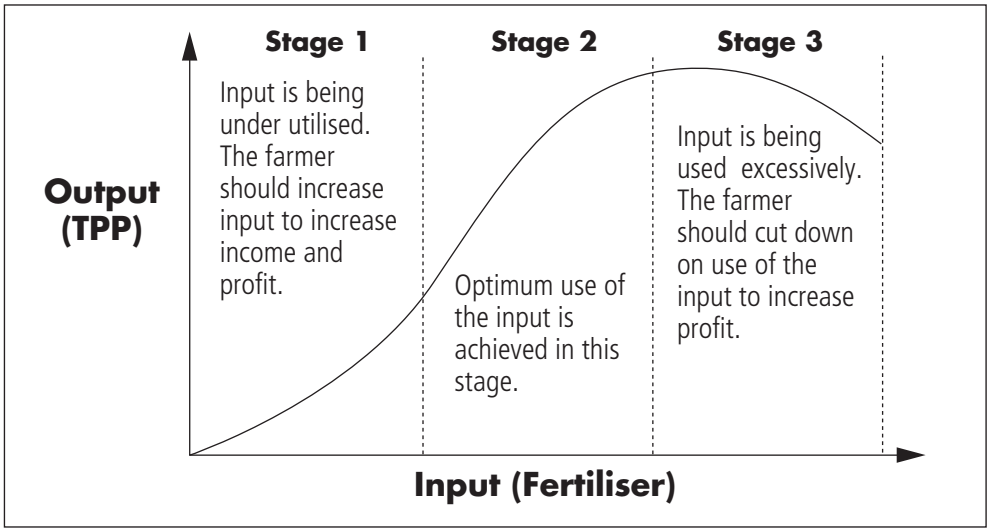


Figure 6.2
Graphic illustration of the generalised production function.

Figure 6.2 shows that in stage one of the production function graph, the total physical product (TPP) is increasing and that through stage two input reaches its optimum level where maximum output is achieved.

In stage three, any use of the input leads to lower TPP. Applying this to our example of fertiliser and beans, it means that too much fertiliser actually reduces yield. In another example, crops can be harvested quickly and efficiently with lots of people (increased input of labour). However, if too many people are employed to do the job at the same time they may damage the crop by trampling on it. There may also be difficulty in supervising the workers, which may lead to inefficiency and lower total output. This is a common problem on school farms where there are too many children harvesting crops together.

If a farmer can achieve optimum returns for input he or she can reduce the unit costs of production, while receiving the same price for each additional unit of produce sold. The exact level of input used will depend on such factors as the cost of the input, the price received for the output, and the risk and uncertainty facing the farmer.

Optimum Output Level

One important decision every farmer has to make is how much to produce. In economic theory, the optimum output to be produced, is found by comparing the marginal revenue (MR) to the marginal cost (MC). Marginal revenue is defined as the change in total revenue as a result of the sale of one additional unit of output.

$$\text{MR} = \frac{\text{Change in total revenue}}{\text{Change in total physical product (output)}}$$

The total revenue of farm production is the sum of market sales of produce and the imputed value of produce consumed by the family and given as gifts. Marginal cost is the additional cost incurred by the farmer for producing one more unit of output. Marginal cost is calculated by dividing the change in total cost of the input by the change in TPP (output).

$$\text{MC} = \frac{\text{Change in total input cost}}{\text{Change in total physical product (output)}}$$

If the MR is greater than the MC, the increase in output will generate more revenue than costs. So the farmer who wants to maximise profits should increase output and continue to increase it until MR equals MC.

Optimum Output — Example

Figure 6.3 illustrates the optimum output produced for the beans–fertiliser production function. The optimum level of output is where marginal revenue is equal to marginal cost i.e. at 350 kilograms of beans per hectare. The farmer then obtains this output level by adding 100 kg of fertiliser per hectare to the farm. Hence, optimum output level is arrived at by the optimum use of the input (fertiliser).

(1) Fertiliser level (kg/ha)	(2) TPP (in kg/ha)	(3) Total cost of input (in tala)	(4) MR (in tala)	(5) MC (in tala)
0	200	-	-	-
20	250	(20 x $5) 100	10	$\frac{100-0}{250-200} = \frac{100}{50} = 2.00$
40	290	(40 x $5) 200	10	$\frac{200-100}{290-250} = \frac{100}{40} = 2.50$
60	320	300	10	3.33
80	340	400	10	5.00
100	350	500	10	10.00
120	355	600	10	20.00

Figure 6.3
Marginal revenue, marginal cost and the optimum level of output for beans – Example of a production function.

Notes on Figure 6.3

Assume the price of beans is 10 tala per kilogram and the price of fertiliser is 5 tala per kilogram

Column 3, the total cost of the input, is calculated by multiplying Column 1 by 5 tala (the price of fertiliser).

Marginal revenue (MR) is the same as the price per kilogram of beans because the farmer acting alone cannot influence the market price.

Column 5 is calculated by dividing the change in total cost of the input by the change in TPP (output) i.e. the change in Column 3 divided by the change in Column 2.

Activity 1 — The Production Function

Materials needed:
Coloured pens;
Graph paper/newsprint;
Ruler;
Calculator.

Aim To understand the production function graph.

1. Copy Figure 6.1 into your exercise book. Complete the table showing the calculations in column 4 and column 5.
2. Make a graph of the information in the completed table (Figure 6.1) and identify the three stages of the production function as shown in Figure 6.2.
3. Copy Figure 6.3 into your exercise book. Complete the table showing the calculations in column 3 and column 5. Identify the optimum level of fertiliser for a crop of beans.

Activity 2 — Case Study — The Production Function

Materials needed:
Coloured pens;
Graph paper/newsprint;
Ruler;
Calculator.

Aim To use a production function graph to find the optimum level of fertiliser for taro production.

1. In groups of three study and complete the table on the next page. Draw and label a production function graph of your results.
2. Identify and label the three stages on the graph.
3. Find the APP and MPP.
4. Find the optimum amount of fertiliser per hectare that should be applied.
5. Find the optimum yield of taro.
6. Present your work to the class.

(1) Fertiliser (NPK) levels (in kg/ha)	(2) TPP (in kg/ha)	(3) APP (kg/ha)	(4) MPP (kg/ha)
0	100		
10	150		
20	190		
30	220		
40	240		
50	250		
60	355		
70	300		
80	250		
90	230		
100	200		

Figure 6.4
Yield of taro at different rates of fertiliser (NPK).

Review

1. Explain the production function.
2. Which is the optimum stage of production? Give reasons.
3. Explain the law of diminishing returns.

Unit 7: PARTIAL BUDGETING

About this unit

This unit will help students develop the skills they need to make better decisions about what to grow. Decisions involving finance usually relate to changes in methods, or volume, of production. To make these decisions you normally need to do an analysis of costs. Partial budgeting helps in that decision-making process by looking at 'parts' of the business farming activity.

Partial budgeting is a financial technique used to assess the effect of a small change on an activity. If it is planned to alter the method of production: *e.g. Using a machine to replace labour, or to grow more of one crop and less of another*, then such a change only involves a part of the whole business.

One method of evaluating the effect of such a change would be to prepare a new budget for the whole operation. This would be very time consuming. It is more efficient to use the partial-budgeting technique in which only those costs and revenue that are affected by the change are considered.

A partial budget is prepared by asking just four questions:

1. What extra costs will be incurred?
2. What existing costs will be avoided?
3. What existing revenue will be lost?
4. What extra revenue will be gained?

Partial Budget	
LOSSES $	GAINS $
1) Extra Cost	2) Cost Avoided
3) Revenue Lost	4) Revenue Gained
Net Loss	**Net Gain**

If the budget shows a net gain there is an increase in profit compared with the existing activity. But remember, it is NOT the overall profit of the business. However, a net gain means it will be better to change to the new proposal while a net loss means that the business will be worse off if the new proposal is adopted.

Example

A root crop producer substitutes 1.0 ha of ta'amu for 1.0 ha of taro. Extra costs are $20 for planting materials, additional revenue is $2000, costs avoided are $270 for labour and revenue lost is $2800.

Losses $		**Gains $**	
A. Extra cost	20	C. Cost Avoided	270
B. Revenue lost	2800	D. Revenue Gained	2000
Subtotal 1 (A+B)	2820	Subtotal 2 (C+D)	2270
Losses – Gains = $2820 – $2270 **Net Losses = $550**			

Decision — Do not adopt the change proposed. Net loss due to proposed change is $550.

How to prepare a partial budget

It is important to collect technical data on the particular aspect being analysed when you prepare a budget or partial budget. This means any person preparing a partial budget must have a sound knowledge of the technical aspects of the partial change in the farming activity that is being considered. They must also know about the farm the budget is being prepared for. If the farmer keeps good farm records, this will help in obtaining the technical information required for the partial-budgeting exercise.

Applications of partial budgets

As well as measuring changes in profitability, partial budgets can also be prepared to measure changes in cash flow which will result from a partial change in the farm plan. In this case, it is usually called a partial cash-flow budget.

Activity 1 Understanding Partial Budgets

Materials needed:
Pen;
Exercise book.

Aim To understand why farmers use partial budgets.

1. In groups of three, read the information on partial budgeting. Do this by dividing the text between the members of your group. Each person is to read their part and explain to the group their understanding of what they have read.
2. Together, discuss the key issues of partial budgeting.
3. In your exercise book, write down the key issues of partial budgeting.

Activity 2 Case Study — Calculating A Partial Budget

Materials needed:
Pen;
Exercise book;
Calculator.

Aim To prepare a partial budget.

1. Divide into groups.
2. Study the table below and copy it into your exercise book.
3. Identify and discuss the differences in costs and revenue between growing head cabbages and tomatoes. Note the extra cost, revenue lost, cost avoided and revenue gained by Paulo.
4. Using the notes from Figure 6.3 on page 55, calculate the difference in income from growing head cabbages and tomatoes i.e. subtotal 1 and subtotal 2.
5. Answer these questions:
   - What is the net gain/loss?
   - What crop do you recommend Paulo to plant?
6. As a class, discuss your results and recommendations.

Case Study
Paulo Tiuna has one hectare where he plants head cabbage. He wants to try tomatoes next season and does some research on tomato production. Paulo recorded the information he gathered in the table below:

	(1) **Head cabbage**	**(2)** **Tomatoes**
Yield (kg)	45000	25000
Price	$3/kg	$3/kg
Cost of seeds	10 pks @ $55	20 pks @ $125
Cost of fertiliser	5 bags @ $50	3 bags @ $60
Cost of insecticide	1 container @ $110	1 container @ $120
Labour	Family	Family

Review

1. What is partial budgeting?
2. Explain why farmers use partial budgeting?
3. Explain the steps in calculating a partial budget?
4. List the advantages and disadvantages of using partial budgets.
5. What other techniques help farmers make better financial decisions?

Unit 8: MARKETING

About this unit

This unit looks at the marketing of produce. After completing the unit students should be able to understand what marketing is, and its importance to farmers and related business people in terms of setting prices, controlling quality and making sales. This unit is both useful and practical. Students will have a better understanding of what is happening in shops and marketplaces.

Marketing is the whole process that occurs after the production of any goods or services and before their consumption.

A market exists when buyers wishing to exchange money for goods or services have contact with sellers wishing to exchange goods or services for money. It is a system of inter-communication (a network of dealings) that exists to enable buyers and sellers of goods, services and resources to make contact. It does not simply mean a physical marketplace. Also, there are many different markets for a product — each with different characteristics and purchasing methods.

The essential principle of marketing is that businesses thrive by producing only what they can sell profitably. For a business to exist, or to continue, it must identify and satisfy consumer needs and make a profit. Unless consumers believe they are getting value for money, they will probably not buy a product. Successful firms are market- or consumer-oriented rather than product-oriented. A market-oriented firm:

- Identifies what people need or want.
- Arranges its resources so that the end product will meet the identified need or want.
- Uses suitable marketing techniques to sell its product.
- Ensures that both buyer and seller benefit from any transaction.

Figure 8.1
Produce market.

Importance Of Marketing

It is important for national economic development to raise the level of farm production. It is equally important to develop marketing strategies so that the extra output reaches consumers efficiently. In a competitive economy greater marketing efficiency will not only give farmers higher prices but, also, give consumers lower prices, increasing their buying power.

Marketing Functions

What happens to products between their production and purchase by consumers? Successful marketing presents goods to consumers in such a way that benefits both producers and consumers. When developing a marketing plan it is essential to consider the following:

- **Assembling**. Collect the product so that it is available in large enough amounts to attract large buyers: *e.g. A group of village farmers group their taro so that their large number of products will have some influence on the market*.
- **Preparing**. Also called merchandising, this means to present goods in the most appealing and convenient way for buyers.
- **Grading**. It is essential to maintain a high quality. Everyone involved in production must understand the grade standards: *e.g. For a fruit crop this may include shape, evenness of size, condition, and freedom from pests and disease*.
- **Processing**. Many farm products require processing to make them easier to consume: *e.g. Milling grain for human consumption or animal feed,* or store: *e.g. Canning fruit*. This adds value to the product, increasing the price.
- **Packing**. This makes some products, such as eggs and sugar, easier to handle, saving on storage space and transport costs. It also helps to keep produce clean, protecting it from damage, and adding value. It is essential to wrap food hygienically and the package should offer consumers a known quantity and standard of quality.

Figure 8.2
Marketed products.

- **Storage**. Also called warehousing, storage costs widen the gap between farm prices and consumer prices for goods.
- **Transport**. This is a crucial aspect of marketing and distribution. All surplus farm products need to be transported to the marketplace, either by farmers or their agents.
- **Distribution**. Traders, wholesalers and retailers are all involved in distribution. Long distances and high transport costs increase the consumer price.
- **Publicity**. Advertising and other promotional activities help create a demand for products.
- **Selling**.

Price Fixing

The price of a product in an open market depends on supply and demand. If the supply of a product is small and many people want to buy it, the price will be high. If a product is in plentiful supply but there are few buyers, it will be cheap to buy. This is common straight after harvest with seasonal crops for which the price is uncontrolled.

The selling price of a product is critical to its profitability. Therefore, it is important to understand how sellers fix their price and what prior research they need to do. As sales, finally, depend on consumer attitude to the selling price, consumer reaction is important for fixing the price of goods and services.

Two basic factors affect the price of a product:

- The production cost.
- The market.

The most common pricing methods are:

- The cost plus method.
- Marginal pricing.

The Cost Plus Method

Farmers selling produce locally will usually set the price for their produce by dividing the volume of produce by the sum of the input costs. This will give them a cost per unit of production. They will then decide how much they need to add on for profit. In the example below, the farmer has decided that 20 per cent of the unit cost will allow him or her enough profit overall if he or she produces 6,000 bags of taro.

Sales forecast	6000 bags of taro
Estimated cost	$4000
Unit cost	$0.67
Add profit margin (20%)	$0.13
Selling price	$0.80

Marginal Pricing

In the cost plus method the estimated costs of $4000 covered both variable costs and a share of common costs. The sale of 6000 bags will cover the common costs that the taro enterprise must meet. Now, if a sudden order that can be filled arrives for another 1000 bags of taro, the common costs have already been covered and any price over the variable cost of production will increase profit.

For example:

Variable cost /unit	$(4000–1000) / 6000 = $0.50
Add profit margin (20%)	$0.10
Selling price	$0.60

Activity 1 Understanding Marketing

Materials needed:
Pens;
Exercise book.

Aim To understand the role of marketing.

1. Divide into groups of three. Divide the information on pages 62–64 into three and each take a section.
2. Read your section and make brief notes.
3. Explain what you read to the rest of your group.

Activity 2 Marketing Plan

Materials needed:
Coloured pens;
Newsprint;
Sticky tape.

Aim To develop a marketing plan.

1. In groups of three imagine you are taro farmers.
2. Draw up a plan to sell 5000 kg of taro in the Apia market.
3. Your plan should look at assembling your produce, preparation, grading, packing, storage, transport, inspection (quarantine), distribution, publicity, selling and price fixing.
4. Present your plan to the class as a flow chart.
5. Follow steps 2–4 for 5000 kg of taro you plan to export to New Zealand.

Activity 3 Determining Price

Materials needed:
Pen;
Exercise book;
Calculator.

Aim To understand the relationship between unit cost of production and selling price.

1. In the same groups of three read the information on price fixing.
2. Using the table below, calculate the selling price of 8000 kg of taro which has an estimated cost of $3500.

Sales forecast	
Estimated cost	
Unit cost	
Add profit margin (30%)	
Selling price	

Review

In your exercise book complete the following tasks:

1. Explain the term 'marketing'.
2. Why is marketing important?
3. Describe the cost plus method of price fixing.
4. List the common marketing strategies.
5. List some of the factors that determine the price of taro in the Apia market.

Unit 9: TOOLS, EQUIPMENT AND FACILITIES

About this unit
This is a practical unit, which covers the safe use, storage and maintenance of tools and equipment. Students will research, practise and demonstrate how tools and equipment are used.

Students will learn how to safely use a knapsack sprayer and how to maintain and store it properly.

Using And Storing Tools And Equipment

Tools and equipment must be kept in a secure and safe tool/equipment room. All tools and equipment should have proper areas where they are hung or placed. This will avoid accidents and make good use of space. It will also be easy to establish whether anything is missing. After use they should be cleaned and returned to their storage area. All tools should be oiled before storing away for any length of time. This will prevent them from rusting and keep them in good working order. Regular servicing is important to keep tools and equipment in good working order.

Tools and equipment must be used in the correct way. Using tools and equipment in the wrong way may result in injury or broken equipment.

Application Of Pesticides

Pesticides can be applied as liquids, powders, dust, granules or bait and the method of application will depend on the type of pesticide:

- Liquids are applied by knapsack sprayer or motorised mist blower.
- Dusts and powders are applied with an engine-driven duster or they are mixed with seeds at sowing.
- Granules and bait are spread or laid by hand.

This section concentrates on pesticide spray application by hand-operated, hydraulic, sprayers (knapsacks) and power-driven mist blowers and dusters.

The purpose of spraying is to reduce, stop or prevent pest damage. As with other methods of pest control, spraying has to be carried out correctly if it is to be cost effective.

We know from field experiments that there is a close relationship between good spray application and successful control of pests. So what is 'good spray application'?

Good spray application depends on:

- **Timing**. The spray must be applied at the right time depending on the crop, the pest, and weather conditions. It is essential that sprays are applied at the most vulnerable stage(s) in the life cycle of a pest.
- **Coverage**. It is important to achieve complete coverage of the target area.
- **Application rate**. Apply the correct volume of spray per hectare that has been diluted at the correct rate.
- **Safety**. Always ensure that the operator has followed the manufacturer's instructions concerning appropriate protective clothing and how to handle the chemical.

Timing

It is interesting to compare farmers who follow a regular calendar spray programme, for example every 10 days throughout the season, and others who spray only when regular scouting indicates that a pest is present in damaging numbers. Results show that it is possible to reduce the number of spray applications per season while increasing the quality and yield of the crop by looking for signs of pests and damage.

This is just one of the advantages of an integrated approach to pest control and highlights the importance of attacking a pest at a time when it is at its most vulnerable stage. It also emphasises the need for field advisers and farmers to be aware of the life cycle of the common pests in their area.

Coverage

The basic principle to remember is that for any pesticide mixture, it is more effective when applied to the target as a large number of small droplets than a small number of larger droplets. To achieve this it is necessary to check that the nozzle in the spray equipment is the right one for the job. Experiments have shown that this statement is also true for herbicides, insecticides and fungicides.

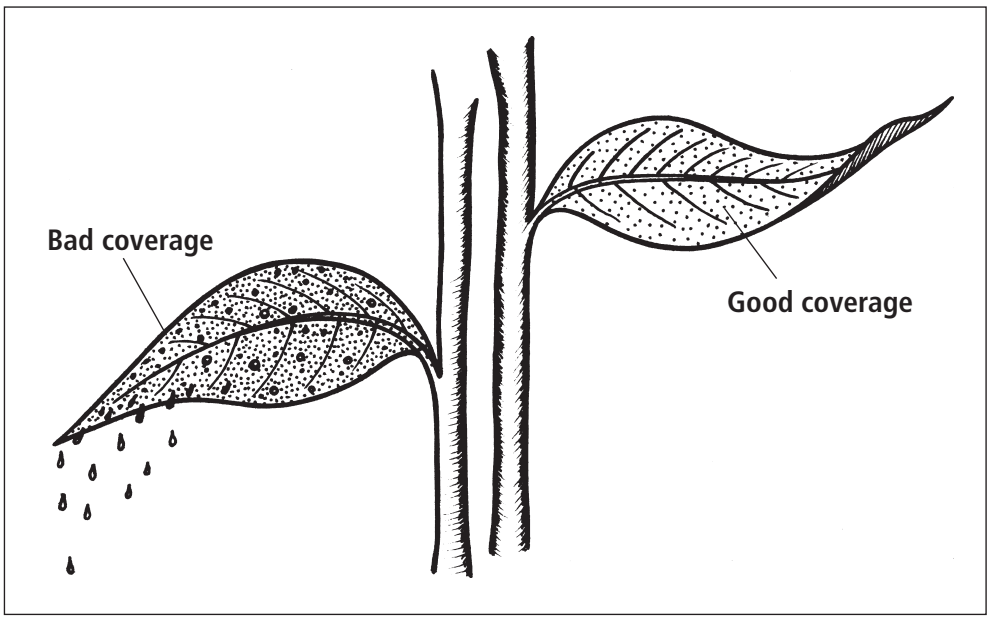


Figure 9.1
Coverage of sprayed liquid.

Coverage is usually expressed as the number of droplets per square centimetre (no./cm^2) and experiments have shown that the optimum application rate for most purposes is 20 droplets per cm^2 on the target area. However, in dense or bushy crops it is often necessary to apply up to 70 droplets per cm^2 on the top leaves in order to achieve 20 droplets per cm^2 on leaves inside the canopy. The number of droplets per cm^2 can be measured using special sensitive paper.

To achieve the correct coverage, it is important that the correct nozzle is fitted to the spray equipment and the manufacturer's recommendations on application rates are followed carefully: they have been calculated to ensure that the correct coverage will be achieved.

Application Rate

Field experiments also show that, provided the correct coverage can be achieved, the volume of water used has little effect on the final result. Manufacturer's guidelines take this factor into consideration.

Application rates are expressed as the amount of product per hectare and instructions usually indicate the volume of water to apply per hectare and give a dilution rate of the chemical in water: *e.g. 300–500 litres/hectare mixed at a dilution rate of 50 ml of chemical to 20 litres of water.* Unnecessarily high volumes of water are a waste of time and effort. They can also lead to run off by causing small droplets to touch and join together. The larger drops pick up more and more small droplets and eventually fall to the ground taking pesticide with them.

Always follow the manufacturer's instructions on the label. They are given to ensure the optimum coverage, provided, of course, that the sprayer is set up and used correctly.

In summary, you need to consider both physical and biological factors, such as the type of crop, leaf surface, mode of action of pesticide, where the target pest is positioned and how it will come into contact with the pesticide, as these will all influence the result.

It is worth remembering at this stage, that fitting the correct nozzles and using the correct pressure while spraying is a critical factor in ensuring that the optimum droplet size, number of droplets and coverage will be achieved; this in turn will ensure maximum benefit from the application.

Safety

Good spray practice requires the spray to be accurately targeted on the crop or pest. Any spray which does not reach the target area is a potential hazard to humans, animals, plants, beneficial insects and the environment. Avoid spraying in any conditions that will reduce the amount of spray reaching the target: *e.g. High wind, wrong nozzle type or size, incorrect speed of travel through the crop*. Remember that lost spray is not only potentially dangerous, but also a waste of money.

Sprayers

The two most common items of spray equipment used by village farmers are:

- Hand-operated pump system (knapsack). This is probably the most common form of spray equipment used by village farmers throughout the world. They are relatively inexpensive, easy to operate and repair and, if well maintained, can last for many years.
- Engine-driven fan system (mist blower).

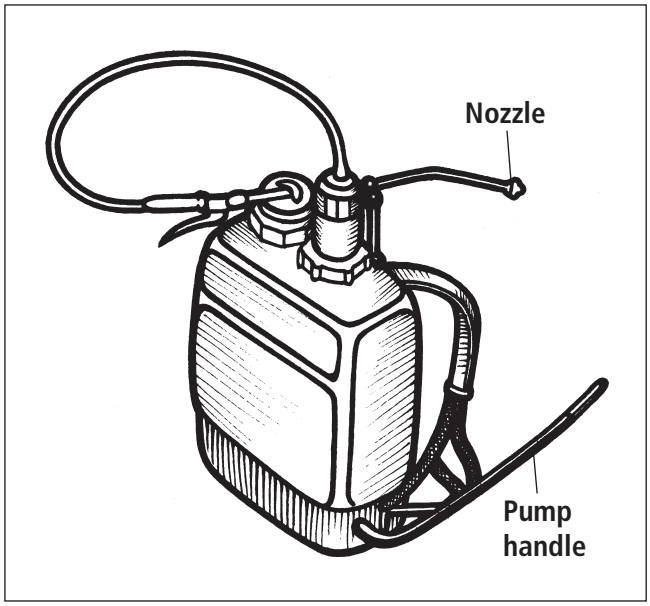


Figure 9.2
Knapsack sprayer.

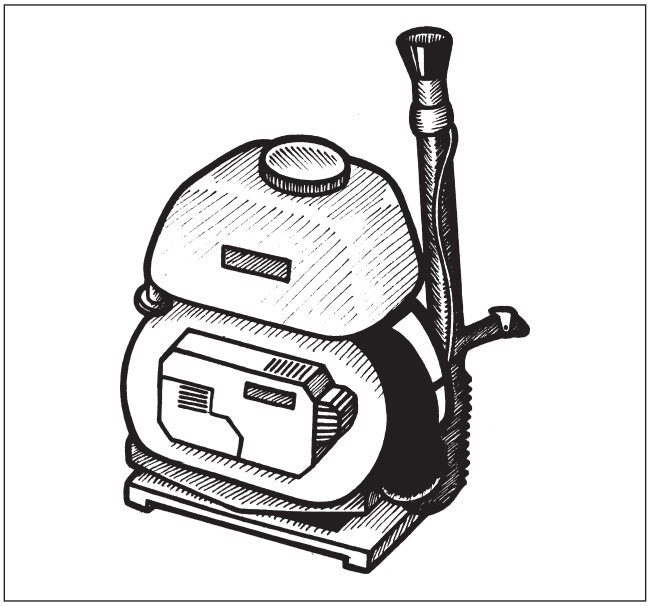


Figure 9.3
Mist blower.

Calibration

Calibration is the process of calculating how much pesticide has to be added to each sprayer tank of water to ensure that the pesticide is applied at the recommended application rate.

The application rate is established through field experiments as the rate which gives the best results. The manufacturer's application rate also assumes that the recommendations on nozzle type, application method and coverage will be followed.

There are a number of important reasons why equipment should be calibrated on a regular basis. Applying less pesticide than recommended can result in the pesticide not working properly. This wastes time and money. It can also lead to the development of pesticide resistance. Applying more pesticide than is recommended can result in damage to crops, residue problems (a major problem in food crops), pollution in soils and waterways and waste of resources.

A look at a number of product labels will show that application rates are normally given in two forms:

1. As a dilution rate: *e.g. 1 litre pesticide in 200 litres water, or 100 ml per 20 litre tank of water.*
2. An application rate per area: *e.g. 2 litres of pesticide per hectare.*

Activity 1 Demonstration

Materials needed:
Coloured pens;
Graph paper/newsprint;
Garden tools;
Knapsack sprayer.

Safety clothing for spraying:
Gloves;
Overalls;
Mask/respirator;
Boots.

Aim To gain practical experience.

1. In pairs select a garden tool.
2. Collect information on the safe use, maintenance and storage of the tool you selected.
3. Create a flip chart showing the correct and safe steps that should be followed when using, maintaining and storing the tool you selected.
4. In pairs, demonstrate this to the class.
5. Follow steps 2–4 with a knapsack sprayer using water.

Activity 2 Evaluating The Effects Of Spraying

Materials needed:
Knapsack sprayer;
Gramoxone;
Exercise book;
Pen;
Measuring tape.

Safety clothing for spraying:
Gloves;
Overalls;
Mask/respirator;
Boots.

Aim To monitor the effects of a weedspray.

1. Watch your teacher spraying weeds in the school garden with *paraquat* (Gramoxone).
2 The next day, in pairs, discuss and evaluate the area your teacher sprayed.
3. Copy and complete the evaluation sheet below in your exercise book.
4. As a class, discuss your observations and evaluations.

Aspect of spraying	**Comments**
1. Coverage Total area Plant:	
2. Effectiveness Parts of plant:	
3. Effect on non-target plants and organisms In the garden: Outside the garden:	
4. Weather conditions when spraying:	
5. Direction of spraying:	
6. Clothing:	
7. Spray rates and mixing:	
8. Applying spray:	
Conclusions	

Review

Complete the following tasks in your exercise book.

1. Why is the correct use, storage and maintenance of tools and equipment important?
2. How should chemicals be stored?
3. Explain the steps for mixing chemicals for spraying.
4. Explain how other organisms can be affected by spraying.
5. What are some other methods that can be used to control pests?

YEAR 11 GLOSSARY

Word/phrase	Meaning
Artificial Insemination (AI)	The insertion of semen into the womb so that an animal or baby can be conceived without mating.
Bone meal	Bones that have been ground to a coarse powder for use as animal feed or fertiliser.
Bos indicus	Includes those humped cattle common to the tropical countries that belong to the Zebu (Brahman) group.
Bos taurus	Includes those domestic cattle common to the more temperate zone.
Branding	The process of placing a mark on cattle skin as a means of identification by heat, laser, fluids or freezing.
Breed	A group of animals that have a common genetic origin and possess certain distinctive characteristics.
Breeding	Mating a male and female of the same species in order to produce offspring.
Brisket	Part of cattle where the ribs join the breastbone — often referred to as the chest of an animal.
Bull	Male cattle.
Calving	The act of giving birth in cattle.
Chronic	Lasting a long time (to describe disease).
Cod	The small bag or pouch that remains in a steer after it has been castrated. The remnants of the scrotum.
Colostrum	A cloudy, yellow-coloured milk containing antibodies produced by mammals during the first few days after birth.
Concentrate	Feed stuff such as grains which are low in fibre and high in total digestible nutrients (TDN).
Cooling	To reduce temperature by storing in a cool room after being washed (of carcasses).
Crossbreeding	Mating of animals of different breeds: *e.g. Hereford x Brahman*.
Crush	The crush or rail, is where the animals are held for treatment, close handling, etc. Another term commonly used name for this is 'race'.
Dam	Mother (of a calf).
Dehorning	The removal of horns by heating, cutting, or chemicals.
Dew lap	Loose skin found on brisket and neck of some cattle: *e.g. Brahman*.
Digestibility	The percentage of voluntary intake of dry matter digested by the body of a beef animal.
Drafting gates	Gates which separate the cattle in stockyards into various small holding pens.
Drenching	The process of forcibly giving drugs in liquid form through the mouth of an animal.

Word/phrase	Meaning
Dry matter	The part of a foodstuff that would remain if all its water content were removed.
Ear tagging	The process of attaching numbered tags on an animal's ear for identification.
Enterprise	A business undertaken for profit, such as a beef project.
Eradicate	To completely destroy or eliminate.
Eviscerate	To remove the entrails and internal organs during the slaughtering process.
Fattener	An animal grown for meat, usually a steer.
Fertility	The degree of reproductive ability in humans and animals. Capable of producing abundant vegetation (in crops).
Fodder crops	Those crops or grasses used for cattle feed.
Forages	Fodder crops (usually green crops, grasses etc) that are lower in total digestible nutrients than concentrates.
Forcing yard	A 'V' shaped yard, much narrower at the end near the crush and leading into the crush.
Gestation period	The time between fertilisation of an egg and birth, or length of pregnancy.
Glue	An adhesive or sticky liquids used to hold things together and may made by boiling beef animal hoofs to a jelly.
Halving	Removing the tail and splitting the backbone (halving) with a power-driven saw, hand saw, or an axe when preparing a carcass for butchering.
Heifer	A young female cow which has not yet had a calf.
Hide	Cattle skin.
Hock	The joint between the knee and the fetlock of a cattle.
Holding yard	The yard that cattle first enter when coming from the paddock into stockyards.
Hybrid vigour	Refers to progeny from two individuals genetically unalike that has the best (strong) characteristics of both parents and is therefore better than either parent.
In-Breeding	Mating of closely related family members: *e.g. Father x Daughter.*
In-calf	Is pregnant or having a calf.
Infertility	Lack of ability to reproduce due to sterility abnormal function of the body.
Infested	In large numbers so as to cause damage or disease (of insects or animals).
Inspection	Careful examination (of carcass to determine suitability for human consumption).
Lactation period	Time when female mammal is producing milk.
Land tenure	A system of holding and owning land.
Leather	Tanned hide/skin of an animal.

Word/phrase	Meaning
Lignin	An organic substance which binds plant fibres.
Linear-breeding	Mating of distantly related family members who both have the same outstanding ancestors with characteristics you wish to retain.
Minerals	Inorganic substances needed for good health in animals and humans, sometimes added to supplementary feed.
Myoglobin	A red protein which carries and stores oxygen in muscle cells and creates the colour in meat.
Oestrus	A recurring period when a cow is fertile and receptive to a bull for mating. Also known as 'being on heat' or 'coming into season'.
Offal	The entrails and internal organs of an animal killed for food.
Offspring	Young, or progeny of animals.
On heat (in heat)	A recurring period when a cow is fertile and receptive to a bull for mating. (Often refer to cow becoming on heat).
Out Breeding	Mating a sire and dam from unrelated families.
Pastern	The part of the leg between the fetlock and hoof (in cattle).
Pedigree	The recorded line of descent of an animal showing that it is purebred.
Performance testing	Evaluating and selecting animals on the basis of their performance or individual merit.
Pester	To annoy, bother, in some cases, to attack.
Pigmented	Having natural colouring matter in the cells of animals and plants.
Poll	A hornless animal, especially one of a breed of hornless cattle.
Pregnancy testing	A method of detecting whether a cow is pregnant or not, usually done by an expert such as a veterinarian.
Production testing	An inclusive term for performance testing and/or progeny testing.
Progeny testing	Selecting animals on the basis of the merit of their progeny.
Protein	A class of food which has amino acids as its basic structural units. Also, structural components of body tissue such as muscle and hair made up of long chains of amino acids.
Protein concentrate	A feed mix high in protein.
Reactor animal	An animal infected with a disease that shows symptoms of the disease.
Receiving yard	The yard that cattle first enter when coming from the paddock.
Resistance	To be not affected by something, especially, lack of sensitivity to a drug or insecticide as a result of continued exposure or genetic change.
Roughages	Rough, bulky foods or fodder: *e.g. Bran, fresh green grass*.
Sanitation	Conditions relating to hygiene and health practices to prevent or control disease and/or parasites, particularly the provision of clean drinking water and adequate waste disposal.

Word/phrase	Meaning
Segregate	To separate from a group.
Shank	The part of the leg in cattle between the knee and the ankle.
Silage	Green fodder compacted and stored in airtight conditions without first being dried, usually in a silo or storage pit. Used as an animal feed.
Silo	An airtight storage pit or closed tower-like structure for storing green fodder.
Sire	Father of a calf.
Skinning	Removing the hide, feet, and head from the carcass.
Slip rails and bale gates	Two ways of holding cattle still when they are in the crush.
Steer	A castrated male less than three years old.
Sticking	To push a sharp or pointed object into something.
Stifle	The joint on the hind leg of cattle between the femur and tibia.
Stunning	Knocking unconscious.
Susceptible	Having little resistance to, easily affected by.
Tattoo	To colour numbers under the skin on the ears of young animals using indelible ink, for identification.
Temperament	The personality and disposition of an animal.
Tolerance	The capability of withstanding different living conditions such as heat.
Topography	The surface features or shape of the land.
Unpigmented	Without colouring, in the cells of animals and plants.
Vaccination (shot)	An injection of vaccine, bacteria, antiserum, or antitoxin to produce immunity or tolerance to disease.
Visual appraisal	Method of determining pregnancy in cows by judging general appearance of the animal.
Vitamin extracts	Complex organic compounds that are essential for normal nutrition, growth, and good health. Vitamins are required in the diet in minute amounts by animals and humans because they cannot be synthesised in the body.
Weaner	A young calf (approximately eight months old) which has been separated from its mother.
Weaning	Separating a calf from its mother to stop suckling.
Yard gates	These gates are often used to push cattle into the next yard, the hatch and the hinges must be strong.

Key Vocabulary for Year 11 Book 2 Agricultural Science

Vocabulary	Useful words that go with the key word	Other words
access	access to water, access roads	accessible
adapt to	adapted to tropical climates	adaptation
additional		add
adequate		
advantage	the advantages of this method	
available		
avoid	avoid visiting infected farms, costs avoided	
balance	a balanced diet	
benefit(vb)	it benefits cattle, it benefits buyers and sellers, cattle benefit from good pasture	
benefit (n)	the benefits of this method are . . .	
capital	farmers need to raise capital, capital expenditure	
consumption		consume, consumer
cycle	cycle of growth	
demand	the demand increases when . . .	
depend on	productivity depends on several factors	
develop	develop a market plan; economic development	development
effect	the effect of fertiliser on production	
effective	an effective method	effectively
efficient	an efficient business	efficiently, efficiency
eliminate		
ensure		
enterprise	undertake an enterprise, embark on an enterprise	
equipment		
essential	it is essential to maintain high quality . . .	
establish	establish a new farm	establishment
exceed		
exist	a market exists . . ., existing revenue	existence
external	external parasites	
fertiliser	apply fertiliser	
finance	raise finance; to have financial skills	financial
form	in the form of	
function		
goods	goods and services	
handle	handle stock, handle goods	
humid	humidity	
identify	identify pregnancy	identification
infect	infected animals; an infectious disease	infectious
injury		injured
inspect		inspection
internal	internal parasites	
involve	the costs involved, everyone involved in production	
isolate		
limitation	the limitations of this method	
location	a suitable location	local, locally
maintain	to maintain fences and yards, to maintain life and growth	

KEY VOCABULARY

Vocabulary	Useful words that go with the key word	Other words
market	a marketing plan	marketing
obtain	to obtain advice, to obtain information	
option	an expensive option, a range of options	
partial	part	
physical		
practice (n)	good practices, modern practices	
prevent	to prevent injury	prevention, preventive
process	the process of digestion	
produce	improved cattle production	product, production, productivity
profit	to raise cattle profitably	profitable, profitably, profitability
promote	promote growth	
quality		
quantity		
relationship	the relationship between two inputs	
scale	on a large scale	
select	select suitable cattle breeds	selection
services	goods and services	
shortage	a shortage of fertile land	
species		
specific	specific measures	
suitable		
technical	technical advice	
technique	a financial technique	
transfer		
value	nutritive value; valuable stock	valuable
vary	conditions vary	variable
vital		
widespread	widespread diseases	

Relating to tools and equipment
good working order, regular servicing, protective clothing, knapsack, hydraulic sprayer, motorised mist blower, duster, pesticide, herbicide, insecticide, fungicide, calibration, coverage, nozzle, application rate, optimum application rate, the manufacturer's instructions, biological factors, physical factors, life cycle, residue, pollution, a potential hazard

Related to the production function
input, output, supply, demand, optimum, to maximise profits, profit maximising, risk, a risky venture, riskless, marginal, marginalism, given inputs, given values, given rates, assume that. . ., is assumed to be. . ., Law of Diminishing Returns, yield, labour, inefficiency, apply fertiliser, incremental change, revenue

Related to cattle breeds and breeding
reproduction, to mate, mating methods, successfully mated, calf, to calve, calving, cow, bull, heifer, dam, sire, herd, agricultural enterprise, susceptible to disease, sexual maturity, Artificial Insemination (AI), pregnancy, gestation period, udder, vagina, vulva, uterus, uterine, sterile, sterility, gene pool, recessive genes

Related to keeping cattle healthy
symptoms of disease, disease prevention, control of disease, treatment of disease, livestock, contaminate, drainage, a wound, irritate, eradicate, insecticide, dip, dipping, dose, vaccination, preventive vaccination, central nervous system, digestive system, chronic, infested, massive infestation, anaemia, diarrhoea

Related to cattle feed and feeding
breathing, digestion, excretion, blood circulation, feed, concentrate feed, nutrition, nutritious, nutrient, energy, reserves of energy, concentrated source of energy, absorb, graze, waste, faeces, urine, dung, manure, legumes, fats, carbohydrates, proteins, vitamins, minerals, supplement, supplementary feed, electrolyte balance, fluid, roughage, fibre, fodder crops, silage, hay, enclosure, rotate, digestibility, voluntary intake, wean, weaner, gullet, intestine, pancreas, liver, anus, ruminants, rumen

Related to partial budgeting
budget, budgeting exercise, incur costs, net gain, net loss, depreciation, capital outlay, proposal, proposed change, analyse, analysis, profitability, cash flow

Related to the history and importance of cattle production
to breed, breeds, pasture, land holders, cattle holders, parasites, fungus (n.), fungi (pl.), fungal (adj.)

Related to marketing
a competitive economy, consumer, producer, transaction, exchange, profit margin, to set prices, promote, marketing strategies, market oriented, consumer oriented, consumer attitude, consumer reaction, preparing, merchandising, assembling, grading, packing, storage, transport, inspection (quarantine), distribution, publicity, selling, price fixing, variable costs, common costs

Related to managing cattle
weed control, pasture planting, yarding, dehorning, branding, ear tagging, slaughtering, dressing cattle, castrator rings, knife, burdizzo pincers, injectable chemical castration, docile, topography, cull, castrate, carcass, drenching, to stock, stocking rate, overstocked, steers, evaluate, requirements, record, expenditure, income, venture, strainer posts, water trough, stunning, sticking, skinning, gutting, inspection, halving, cooling, quartering

Useful structures for Year 11 Book 2 Agricultural Science

Expressing comparison and contrast

A net gain means it will pay to make the change **while** a net loss means the enterprise will be worse off.

For any pesticide mixture, it is **more** effective when applied as a large number of small droplets **than** a small number of larger droplets.

The large-scale enterprises produce **more** beef or milk per cattle unit, **compared to** the semi-commercial and small-holder enterprises.

One method of evaluating the effect of such a change would be to prepare a new budget for the whole operation. It is **more** efficient to use the partial-budgeting technique.

It is important for national economic development to raise the level of farm production. It is **equally** important to develop marketing strategies.

As with other methods of pest control, spraying has to be carried out correctly if it is to be cost effective.

Like many other new techniques, AI has both advantages and limitations.

Describing results

Farmers leave the bulls with the herd all year round. **Therefore**, calving happens throughout the year.

They cause disease by irritating the host animal **so that** it loses its appetite.

This **adds value** to the product, **increasing** the price.

Describing sequences

Once absorbed, food provides energy.

After chewing the food a second time they swallow it again.

After use tools should be cleaned and returned to their storage area.

When the food leaves the fourth stomach it goes into the small intestine. **At this point**, some juices come into the food from the pancreas and the liver.

Sell weaners **before** they reach 200 kg live weight.

Before establishing a new cattle farm, farmers must plan carefully.

Before any cattle arrive make sure that the following things have all been organised.

Before you go, prepare questions on cattle management.

Results show that it is possible to reduce the number of spray applications per season **while** increasing the quality and yield of the crop.

Expressing conditions

If possible, always feed calves with their mothers milk.

If high levels of production are needed, **then** high quality food must be offered.

If the MVP exceeds the price of the input, **then** the input should be increased, because additional income generated exceeds the additional costs.

Unless consumers believe they are getting value for money, they will probably not buy a product.

Descriptive phrases

the energy **needed for this process**

the **required** management skills **to keep cattle profitably**

the **common breeding** methods **farmers practise**

cattle **raised in this way**

one of the **main** sources of protein **for communal gatherings and ceremonial activities**

one of the **most serious and widespread** diseases **affecting the livestock industry**

Giving examples

This unit looks at common health problems in cattle production **such as** poor management, diseases, and internal and external parasites.

It produces energy for vital body processes **such as** breathing, digestion, excretion and blood circulation.

It can be difficult to raise capital for projects **such as** constructing and maintaining fences and yards.

Other factors **such as** available soil nutrients, soil moisture, soil structure, air quality, plant spacing and intensity of light also have an effect.

The exact level of input used will depend on **such** factors **as** the cost of the input, the price received for the output, and the risk and uncertainty facing the farmer.