Achievers Senior Secondary

Agriculture

Student's Book 4 MALAWI

approved

Colden Chamanza

grey matter

Achievers Senior Secondary

Agriculture

Form 4

Student's Book

Golden Chamanza

grey matter
The Education Company

TABLE OF CONTENTS

Chapter 1

Soil degradation

Introduction

Soil is the upper layer of the earth's surface. Soil supports most of the plant life on earth except for aquatic plants. The health of the soil is therefore important as it supports plant growth.

There is a rapid increase in population and therefore people are creating more space for settlement through deforestation. The growing population also needs a constant food supply to be able to ensure there is food security. Therefore, forest land is increasingly getting converted to cultivated land to provide food for the growing population. This puts a lot of pressure on the soil and thus leads to soil degradation. Soil needs to be conserved and managed very well to preserve its nutrients and avoid destroying its structure to increase crop yields. This will ensure that the country has enough food to feed the growing population.

Success criteria

By the end of the chapter, you must be able to:

(a) describe forms of soil degradation

(b) explain the causes of soil degradation

(c) describe the effects of soil degradation on crop production

(d) explain the relationship between rapid population growth and soil degradation

(e) discuss how to control soil degradation.

Definition

Soil degradation is the loss of quality and productivity of soil. This results in the reduction of fertility or loss of the capacity of the soil to support agricultural production. This is caused mostly by human activities. A soil that is degraded has lost its nutrients and organic matter content. This leads to destruction of the soil structure thus making the soil unsuitable for agricultural production.

Fig. 1.1 Degraded soil

Forms of soil degradation

When the topsoil is exposed, soil erosion takes place. This causes the rich fertile soil to be carried away from where it is needed for agricultural use and deposited in faraway places where it is not needed. This causes soil degradation. There are three forms of soil degradation:

- Physical degradation
- Chemical degradation
- Biological degradation

Physical degradation

Physical degradation leads to loss of soil fertility. This form of degradation is mainly caused by soil erosion. Causes of physical degradation include:

- Wind erosion
- Water erosion
- Physical deterioration

a) Wind erosion

Wind is a natural agent of soil erosion. Wind erosion occurs when soil that is not covered with vegetation is blown away by strong winds and deposited in a different place. This leads to the removal of the top fertile soil thus reducing fertility of the soil. Soil erosion and loss of fertility lead to degradation. Wind erosion mostly occurs during the dry season because the soil has been burnt by the sun and has become loose.

Fig. 1.2 Wind erosion on land without vegetation cover

b) Water erosion

Water is the main agent of soil erosion in Malawi. Water erosion occurs when soil particles are washed away by runoff water and are deposited in a different area. The forms of water erosion include:

- Splash erosion
- Sheet erosion
- Rill erosion
- Gully erosion

Fig. 1.3 Impact of raindrops on the soil surface

Splash erosion

Splash erosion occurs when raindrops hit the surface of the earth that has no vegetation cover. The soil particles are therefore made loose. The impact of the raindrops on the soil surface causes soil to be detached from the ground. This leads to the destruction of the soil structure.

Fig. 1.4 Sheet erosion

Sheet erosion

Sheet erosion is the uniform removal of topsoil by agents of erosion such as running water or wind. This type of erosion usually occurs on sloping land.

Fig. 1.5 Rill erosion

Rill erosion

Rill erosion is the removal of soil by water running through small channels. The runoff water forms small channels as it goes down a slope.

Fig. 1.6 Gully erosion

Gully erosion

As the intensity of rainfall increases, the speed of runoff water also increases. The channels formed from rill erosion develop into gullies. Gullies are wide and deep. Soil carried away through gulley erosion is usually deposited in water reservoirs. Gullies hinder the cultivation of land.

c) Physical deterioration

Physical deterioration occurs when the soil structure is destroyed by heavy machines such as those used during ploughing. The soil particles that have been broken down are eroded by wind or running water causing physical deterioration of the soil.

Fig. 1.7 Heavy machines break down the soil structure

Chemical degradation

Chemical degradation leads to loss of soil fertility, soil pollution, loss of soil nutrients or organic matter, reduction in soil pH and an increase in soil salinity. The use of chemical fertilisers leads to acidification of the soil thus lowering the soil pH. This makes the soil not suitable for agricultural production.

Excessive salts in the soil lead to an increase in soil salinity. This prevents water from reaching the roots of plants. This type of soil cannot support plant growth.

Industrial wastes, oil spills, excessive use of insecticides, herbicides and fertilisers lead to soil pollution. They also lead to acidification of the soil. The soil then becomes too toxic leading to degradation.

Loss of soil nutrients or organic matter lowers the fertility of the soil. The soil cannot support plant growth. It is thus left bare leading to degradation.

Biological degradation

Biological agents that cause soil degradation include human beings, animals and micro-organisms that are found in the soil. Human activities such as poor cultivation practices and deforestation lead to soil degradation because they cause soil erosion.

When many animals are kept on a small piece of land, they trample on the ground and loosen the soil particles. This increases the likelihood of soil erosion through runoff water.

Activity 1.1 Discussing forms of soil degradation

(a) Under the guidance of your teacher, visit areas around your school to observe physical and chemical forms of soil degradation.
(b) In groups of five, discuss your findings.
(c) Observe pictures of degraded areas during the discussion and make short notes in your exercise books.
(d) Present your findings in class.

Causes of soil degradation

Soil degradation is a threat to natural forests and agricultural production in the country. The following are the causes of soil degradation:

1. Overgrazing – This is the practice of keeping large numbers of livestock on

a small piece of land. This leads to the destruction of grass and other vegetation. The soil is then left bare leading to soil erosion. The animals also step on the ground constantly loosening the soil particles which makes it easy for the agents of erosion to carry away the loose soil.

Fig. 1.8 Effects of overgrazing

2. Monoculture – This is the practice of growing a single crop on large areas of land year after year. It leads to the build-up of pests and diseases in the soil. Specific nutrients are also reduced in the soil since the crops use up the same nutrients every year. These lead to the destruction of the soil structure.

3. Poor cultivation practices – Poor cultivation practices such as ploughing along the slope lead to an increase in soil erosion through wind and runoff water. The use of heavy machines during cultivation also leads to physical deterioration of the soil. Crops grown on land take up nutrients from the soil. Failure to replenish the used up nutrients causes soil degradation.

4. Excessive use of chemicals – Excessive use of chemical fertilisers and pesticides lowers the soil pH. The soil becomes acidified and thus cannot support plant growth. The land is left bare without any ground cover. This leads to an increase in soil erosion.

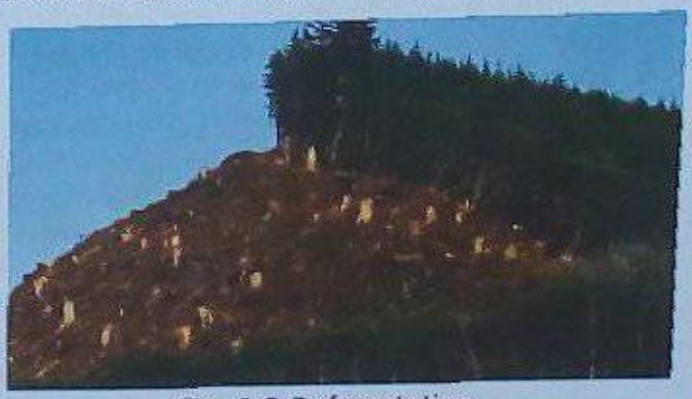

Fig. 1.9 Deforestation

5. Deforestation – This is the practice of cutting down trees for fuel or to create land for settlement and cultivation. The land is left bare thus exposing the soil to erosion by wind and water. This is one of the major causes of soil degradation in Malawi.

Activity 1.2 Developing a cause-effect problem tree on soil degradation

(a) In groups of five, list the causes of soil degradation.
(b) Discuss the causes of soil degradation with your group members. Write down short notes.
(c) Your teacher will demonstrate to you how to come up with a cause-effect problem tree. Develop a cause-effect problem tree on soil degradation with your group members.

Effects of soil degradation on crop production

Soil degradation has a huge impact on crop production. The effects of soil degradation on crop production are:

1. Loss of topsoil – The topsoil contains humus which makes it very fertile. Soil degradation leads to loss of the topsoil leading to a reduction in soil fertility. Crops do not thrive well in infertile soils. Therefore, there will be a decrease in crop production.
2. Reduction of arable land – Soil degradation through erosion leads to reduction of arable land. The soil structure is destroyed and the land is not suitable for crop production. The land is left fallow leading to a decrease in arable land. The formation of gullies through gully erosion leads to a waste of huge tracts of land that could otherwise be used for arable farming.
3. Spread of water-borne and soil-borne diseases – Water-borne and soil-borne diseases are spread through water and wind erosion. Soil that has diseases is carried to areas where the soil is healthy. This soil will be infected by the diseases leading to a reduction in crop yields.
4. Famine – Reduction of arable land leads to less crop production. This leads to famine and food insecurity. It may lead to death of people.
5. Silting – Erosion of degraded soil causes soil particles to be deposited in water reservoirs. The deposition of soil particles in water reservoirs is known as silting. This leads to reduced water levels in the reservoirs.

Fig. 1.10 Silting

6. Pollution of water sources – Deposition of soil in water resources leads to pollution of water sources. This is because the soils contain fertilisers, industrial wastes and pesticides. The contaminated water is used by farmers for irrigation. It therefore leads to a reduction in crop yields or loss of crops.
7. Flooding – Lack of vegetation cover on the soil due to degradation makes an area susceptible to flooding since there is no vegetation to reduce the speed of running water. Floods destroy crops leading to crop failure.

Fig. 1.11 Crops damaged by flooding

8. Desertification – The increase in deserts means that there are fewer forests. Therefore, the air that we breathe is contaminated since there are not enough trees to purify the air. This makes many people to have health problems reducing the workforce that could be used to cultivate crop land. This leads to food insecurity and rampant cases of malnutrition.

Activity 1.3 Discussing the effects of soil degradation on crop production

(a) In class, list and discuss the effects of soil degradation on crop production.
(b) Take down notes in your notebooks during the discussion.

Relationship between rapid population growth and soil degradation

Population growth leads to a wide range of activities which in turn lead to soil degradation.

1. Overcultivation – High population growth rate leads to overcultivation of the land left after the settlement of people. To feed the growing population, sufficient food needs to be produced from the soil thereby causing pressure on the soil. Nutrients are then depleted from the soil due to soil erosion from poor farming practices. The soil becomes acidified because of excessive use of fertilisers, thus the crop yields progressively become low.
2. Deforestation – A lot of forestry land is normally cleared to give way for human settlement. This leads to reduction in forests and natural vegetation leaving land bare. Soil erosion by water and wind is increased leading to soil degradation.
3. High demand for wood fuel – A high percentage of the population of Malawi use charcoal and firewood for fuel. An increase in the population leads to an increase in demand for fuel. Thus, deforestation is rampant leading to further soil degradation.
4. Industrialisation – Many industries are started to provide employment for the growing population. The wastes from these industries are deposited into rivers and other water bodies. The water is then used for irrigation causing soil pollution.

Activity 1.4 Researching on the effects of rapid population growth on soil degradation

(a) In groups of five, carry out research in the school library on the effects of rapid population growth on soil degradation. Observe some of these effects in your local environment.
(b) Discuss the relationship between rapid population growth and soil degradation.
(c) Present your findings in class.

Ways of controlling soil degradation

Afforestation and reforestation

Afforestation is the planting of trees where they did not exist before. Reforestation is re-growing or re-establishing of trees in areas that once had trees which were removed. This will help reduce water and wind erosion and also improve the soil structure thus controlling soil degradation.

Fig. 1.12 Planting of trees

Good farming practices

Proper farming practices such as cultivating across the slope should be done to reduce soil erosion due to run-off water. Conservation farming should also be practiced to maintain the soil structure and prevent soil erosion.

Farmers should also practice rotational grazing to prevent soil degradation through overgrazing.

Crop rotation should also be practiced to restore soil nutrients and to improve the soil structure. This will also ensure that lost soil nutrients are replenished.

Mulching and planting cover crops

Mulching is the process of covering the ground surface with materials such as plant residues, manures and plastic sheets. Cover crops are crops that are grown to protect the ground from wind and water erosion. These practices help to conserve soil and water and thus help in reducing soil degradation.

Proper disposal of industrial wastes

Chemical wastes from industries should be disposed of properly and not in water bodies. This will reduce water pollution which in turn will reduce soil pollution and prevent chemical degradation of soil.

Controlled use of chemicals

Chemicals such as fertilisers cause acidification of soil, especially when used excessively. This degrades the soil as it cannot be used for agricultural production unless the acidity is reduced. Affected soils can be restored through liming. The use of pesticides should also be reduced. Farmers can opt to use biological control methods or integrated pest management systems to control pests.

Activity 1.5 Practising controlling soil degradation

(a) In a class discussion, suggest and discuss other ways of controlling soil degradation that have not been mentioned in this book.

(b) Your teacher will demonstrate to you how to control soil degradation.
(c) In groups of five, practice how to control soil degradation in your local environment by planting trees.

Practical activities

1. Take a walk in areas around your school and record the effects of soil degradation in your notebooks.
2. Analyse records of farm produce from fields in your local area over the years and determine the increase or drop in yields.
3. Outline the causes of the reduction in yields.
4. In small groups, discuss the causes of soil degradation in the area that you live in and ways of controlling the degradation.

Summary

- Soil is a basic natural resource that supports plant life, thus its health is of utmost value not only to the farmers but to the entire human race and other living things. It is important that the soil is protected from degradation.
- Increasing demands for increased levels of food production to support the human population, and rising demands for agricultural commodities have led to a rise in the growing need to convert forests and grasslands to farm land.
- The changes collectively continue to cause a shift from natural ecosystem to agriculture leaving the land (soil) unable to sustain crop and animal life.
- Soil loses its quality and productivity due to human actions like overgrazing, monoculture, poor land cultivation practices, continuous use of agro-chemicals and growth of crops without replenishing lost nutrients.
- Population increase leads to pressure on existing resources, deforestation, accumulation of wastes and release of industrial wastes into the soils and rivers.
- Soil degradation leads to loss of agricultural productivity, increased rate of natural disasters such as floods due to deforestation, loss of water quality due to contaminated water ways, water-borne diseases; some vegetation and soil living organisms may become extinct.
- Desertification leads to climate change which ends up affecting the quality of air that we breathe and reduced food output resulting in starvation and poor nutrition.
- In order to enhance the quality and productivity of soils, farmers must implement afforestation and reforestation programs.
- Practices that lead to cutting down of trees like charcoal burning must be banned and alternative sources of energy sought. Farmers must avoid overstocking which often leads to overgrazing and subsequent exposure of soil to soil erosion.
- Farmers must practice soil and water conservation measures such as terracing and avoiding cultivation across steep slopes.

Chapter 2

Agriculture and climate change

Introduction

Agriculture is an important sector in Malawi. Majority of the people, especially those living in rural areas, practice agriculture. Agriculture helps in the economic development of the country and in the provision of food to people.

For agricultural production to be successful, there must be favourable climatic conditions. The soil must also be fertile and must have a good structure. However, various human activities have led to a change in climate and caused soil degradation.

An increase in the population leads to a higher demand for food for the growing population. Therefore, new farming practices need to be put in place to curb the problem of climate change.

Success criteria

By the end of the chapter, you must be able to:

(a) list ways of dealing with climate change in agriculture

(b) describe ways of dealing with climate change in agriculture

(c) explain how each measure can deal with climate change.

Ways of dealing with climate change in agriculture

Climate change is defined as the change of the climatic or weather patterns over a period of time. Climate change may lead to global warming. Global warming refers to the increase in the average temperatures on earth. Climate change may be caused by agriculture because through agriculture, greenhouse gases such as carbon dioxide are released into the atmosphere leading to an increase in temperature.

The problem of climate change has to be addressed in order to increase and improve agricultural production. There are several ways of dealing with climate change in agriculture. These include:

- Conservation agriculture
- Water harvesting
- Agroforestry
- Reforestation
- Integrated farming

Activity 2.1 Researching on ways of dealing with climate change

(a) In groups of six, research from your school library or the Internet on ways of dealing with climate change in agriculture.

(b) Describe ways of dealing with climate change in agriculture and outline the activities that are carried out in each method.

(c) Present your findings in class.

Conservation agriculture

Conservation agriculture refers to resource-saving agricultural production that aims at achieving acceptable profits using high and sustainable production input levels while conserving the environment.

Fig. 2.1 Conservation agriculture through ploughing without removing vegetation cover

Sustainable agricultural production ensures that profits are attained and the livelihood of farmers is improved. This can be done through implementation of practices such as:

- minimal soil disturbance
- planting and maintaining soil vegetation cover
- practising crop rotation.

Minimal soil disturbance refers to a process whereby mechanical cultivation or disruption of the soil structure is reduced in order to maintain soil nutrients, minimise soil erosion and conserve water in the soil.

Fig. 2.2 Vegetation cover helps to preserve the topsoil

Planting and maintaining soil vegetation cover is an aspect of soil management that helps to preserve the topsoil against the agents of soil erosion. This practice leads to an increase in soil living organisms and their activities. The accumulation of soil living organisms increases the rate of decomposition and build-up of organic matter in the soil to provide relevant nutrients. The soil cover helps to prevent soil erosion.

Crop rotation is essential in conservation agriculture as it helps in controlling pests and diseases by preventing their build-up which is caused by monocropping. It also helps in reducing weeds in the farm. By controlling weeds and pests, there is an increase in agricultural production. The structure of the soil and porosity is also improved. This causes the soil to have good drainage and good water holding capacity making it suitable for crop production.

Agroforestry is a key factor in fighting the consequences of climate change. With two or more plant species interacting in a given area, they create a sustainable environment that can support a wide variety of birds, insects and animals besides modifying the temperature of that particular area.

Agroforestry and climate change

The following are the benefits of agroforestry as a climate change modifier.

- Trees can act as a source of income to farmers since they can be sold as timber or wood. The trees are also a source of wood fuel needed in most homes for cooking. This will help in reducing deforestation and thus reduce global warming too.
- If leguminous trees are planted alongside crops, they fix nitrogen into the soil. The leaves and branches that are pruned from the trees act as mulch and conserve soil water. This helps to restore the fertility of the soil and increase organic matter content. Therefore, the farm produces high yields of crops that ensure there is food security in the country.
- Agroforestry helps to conserve soil and water by providing mulch for the soil and also reducing the speed of wind. This helps in reducing soil erosion through wind and runoff. The nutrients are thus maintained in the soil leading to an increase in crop production. The trees also protect the crops from excess temperatures by providing a cool atmosphere thus helping to reduce the effect of climate change on crops.

Reforestation

Reforestation is the planting of trees or re-establishing of forests in an area that had trees which were then cut down. This can be done in a natural way where the forest cover is allowed to re-grow. It can also be through the actual planting of trees in areas that have been depleted through deforestation.

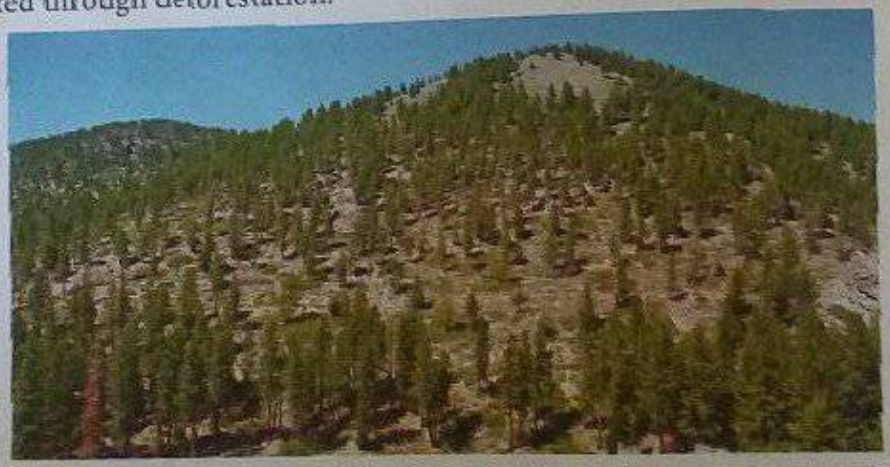

Fig. 2.5 Trees re-grown in an area where they once existed

Reforestation helps to improve the quality of human life by absorbing pollutants and dust from the air. It restores the natural habitats and ecosystems. It is a key way of reversing global warming since trees balance the amount of carbon dioxide available in the atmosphere

Reforestation and climate change

Forests play a big role in the global carbon cycle because trees and plants absorb carbon dioxide through photosynthesis and thus eliminate the greenhouse gas from the air. Forests serve as natural carbon sinks in that they store large amounts of carbon. Through reforestation, carbon emissions are offset from the air and this helps to fight climate change.

Integrated farming

Integrated farming is a type of farming system where crops are grown with trees; livestock are also kept and fish production practised on one farm. It is referred to as the integrated forest, crops, livestock and fish systems. They are all linked to each other. Livestock and fish production systems can satisfy the need if they fit in the environment.

Integrated farming and climate change

Climate change leads to depletion or degradation of resources. The integration of forest, crops, livestock and fish farming helps in dealing with climate change. Trees help in reversing climate change by absorbing carbon dioxide from the atmosphere thereby reducing global warming. Wastes from crops and the by-products of crops are used as livestock feed. Finally, the water that is drained from the fish pond is recycled and used for irrigating the crop fields. Faeces and urine from livestock are used as farmyard manure to improve soil fertility for crop production or to generate biogas for cooking. In cases where there is a slaughterhouse on the farm, the blood mixed with water obtained from slaughtering animals is channelled into the fish pond. There are various aquatic plants that grow in the fish pond. They can be removed and used as feed for livestock.

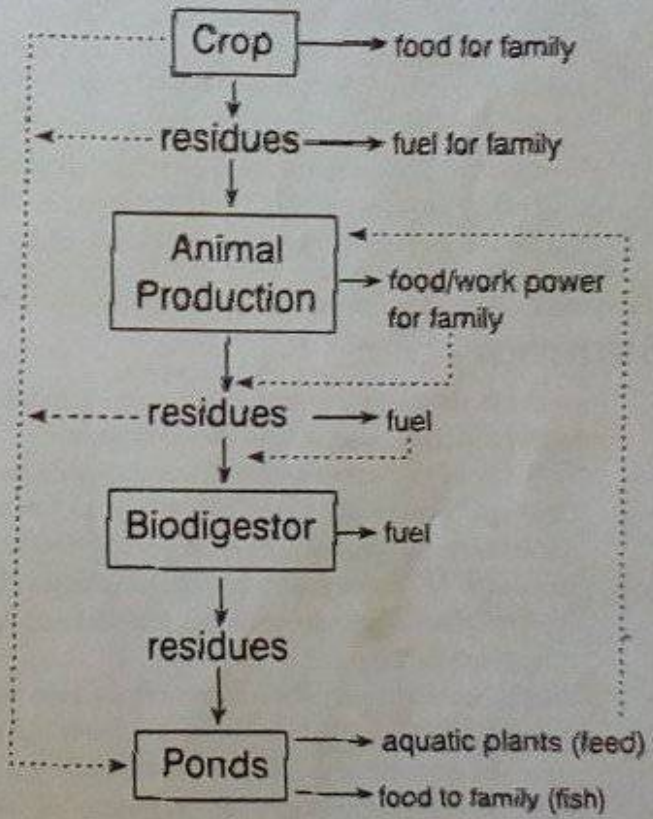

Fig. 2.6 Flow chart showing the integrated farming system

Activity 2.2 Discussing ways of dealing with climate change in agriculture

(a) In groups of five, discuss the findings presented in class during Activity 2.1
(b) Discuss how each measure mentioned helps to deal with climate change.
(c) Present a summay of your findings in class.

Practical activities

1. Find out the agricultural practices that were carried out in your local area in the past. Identify the agricultural practices being used now.
2. Find out the changes in climate that have occurred in your local area over the past five years.
3. Through interviews to farmers and other resource persons in your local area, find out what might have caused the climate change. How has this affected agricultural production?
4. Find out ways through which farmers deal with the effects of climate change in agriculture.
5. Find out an area in your locality which requires conservation agriculture to be practiced. Do this as a class project. Educate the farmers around your school on the benefits of conservation agriculture after you have successfully completed the project.

Summary

- Agriculture plays an important role in meeting the human food requirements in tropical Africa, and Malawi is no exception.
- Majority of the agricultural world depends on favourable climatic conditions.
- Through human activities, changes have been realised to the extent that they affect climatic conditions and overall production levels.
- The ways of dealing with effects of climate change in agriculture are by practicing conservation agriculture, water harvesting, agroforestry, reforestation and through integrated farming.
- Water harvesting is the collection of rain water from the surface which directly receives it. Water can be harvested from the roof of a building, the river or a paved area like a terraced courtyard of a building.
- The use of agroforestry as a means of dealing with climate change involves incorporation of trees in your farming.
- Reforestation involves planting of trees or allowing vegetation to re-grow where they once existed.
- Integrated farming involves the growing of crops together with trees, keeping livestock and rearing of fish on one farm.

Chapter 3

Land drainage

Introduction

Land drainage is an aspect of soil management practice aimed at improving the productivity of the land or the use of land for different purposes. It aids in the removal of excess water on the surface of land to improve the quality of the soil for agricultural production.

Success criteria

By the end of the chapter, you must be able to:

(a) state the meaning of the term 'land drainage'

(b) explain the importance of land drainage

(c) describe methods of land drainage.

Definition

Land drainage is the removal of excess surface and sub-surface water on land that is to be used for agricultural production through open ditches or pipe drains. Dykes can also be created and the water directed to drain in them. Land drainage is carried out in agriculture, forestry, urban areas for industrial construction, sports fields and other recreation areas.

Fig. 3.1 Low lying land usually has poor drainage

Poor drainage may arise due to the structure of the soil and the topography of the ground which does not allow faster surface runoff.

Deforestation alters the rate in quantity and distribution of rainwater and hinders percolation due to absence of soil cover. This results in flooding and erosion leading to poor land drainage.

Importance of land drainage

1. Land drainage enables human beings to reclaim land from low-productivity areas such as swamps, marshes and waterlogged areas for agricultural use.
2. Land drainage helps to improve a particular area and increase its efficiency and productivity when used for crop production.

3. Land drainage reduces pollution and accumulation of chemicals and industrial wastes in water.
4. It reduces the spread of water-borne diseases.

Activity 3.1 Discussing the meaning and importance of land drainage

(a) As a class, brainstorm the meaning of the term 'land drainage'. Discuss the meaning of the term.
(b) List and discuss the importance of land drainage.
(c) Take down short notes during the discussion.

Methods of land drainage

Agricultural drainage systems are used to remove excess water on or in the soil to create more land suitable for crop production. Methods of land drainage include:

- surface drainage
- sub-surface drainage
- bio-drainage.

Surface drainage

This is the removal of excess water from the surface to restore land for crops and pasture. It also helps to remove stagnant water from the land surface. This type of drainage operates through gravity. There are two types of surface drainage systems:

- open drains or ditches
- bedding system or grassed waterways.

Open drains or ditches

This technique of surface drainage includes use of open trenches or drains. The open trenches drain the water into deeper drains where the water is collected. For efficient operation of the open ditch drainage, ensure the following:

- the channels should, if possible, be covered to ensure safety
- the depressions should discharge runoff water appropriately
- the channels should be levelled so that they can collect and remove the water.

Fig. 3.2 Open ditch surface drainage system

Bedding system or grassed waterways

This is one of the surface drainage systems which is practiced in fields where crops are grown. The width of the bed will depend on the type of crops grown. In permanent

pastures, the beds should be wider. The bedding system is made through ploughing. The bed will have a high slope at the end to lead the excess water away.

Fig. 3.3 Grassed waterway or bedding system

This is made possible through the collecting drains at the end of the bed. The drains collect and lead the excess water to the desired location.

Sub-surface drainage

This is the removal of water below the land surface. This can be done through the use of open ditches but it is more commonly carried out using a network of pipes.

The system consists of perforated plastic pipes that are laid into the trenches which are dug in the ground. Small stones are aligned over the pipe and the drain in the trench. The system allows water to easily drain into the land through piping. Water is evenly distributed underground by the pipes.

Fig. 3.4 Sub-surface drainage system

Sub-surface drainage can also be done using tiles which function similarly as the plastic pipes. However, the plastic pipes are preferrable because they are light, elastic and firm, which makes it easy for portability.

Bio-drainage

This is the removal of water from the soil surface by growing crops. Bio-drainage helps in reclamation of salt affected land and waterlogged soils. Plants that have deep roots such as trees should be planted so that they can use up the excess water available in the soil. The water is taken up through the roots and lost from the leaves through the process of transpiration.

Fig. 3.5 Planting of deep-rooted trees helps in bio-drainage

Fast growing tree species such as the eucalyptus are usually used. They require a lot of water for growth. This will help in creating more land for crop growth and improve the nutrients intake in the soil.

Activity 3.2 Describing methods of land drainage

(a) In groups of five, suggest methods of land drainage and list them in your notebooks.
(b) Describe each method of land drainage and observe pictures of the different methods of drainage.
(c) Present your findings in class.

Practical activities

1. Visit a swampy area or any waterlogged areas that can be found around your school and where land reclamation is being carried out.
2. Observe the various methods of land drainage that are being used to remove the excess water from the soil.
3. Find out how each method works from the resource persons in that area and take down notes during the visit.

Summary

- Drainage is the removal of excess water from the soil surface. Drainage helps to ensure that soils remain productive.
- Methods of land drainage include the use of open ditches, sub-surface tile and pipe drains, or through the creation of dykes and ploughing water from the affected area.
- Drainage is done in agriculture, forestry and in urban areas during industrial construction, creation of sports fields and other recreation areas.

- Land drainage helps in bringing wasteland into use. The areas that are often reclaimed include swamps, marshes and waterlogged areas.
- Excess water on land leads to reduced populations of soil micro-organisms like bacteria which help in fixing nutrients and decomposition of organic wastes.
- Excess amounts of water in the soils lead to increased accumulation of chemicals and thus reduced decomposition of wastes. This also creates a breeding ground for disease-causing organisms.
- There are two types of drainage: surface and sub-surface drainage systems.
- Surface drainage involves removal of excess water from the soil surface. This involves the use of open ditches. Precautions must be undertaken to protect the drainage channels by covering them.
- Sub-surface drainage systems consist of perforated pipes which are laid in trenches or undertaken to drain off excess water.
- Sub-surface drainage can also be done by using tiles which function similarly as the plastic pipes.

Revision questions 3

1. What is the meaning of the term 'land drainage'?
2. List three methods of land drainage.
3. Describe the bio-drainage method that is used to drain excess water from the land.
4. Outline the importance of practicing land drainage.
5. (a) What is surface drainage?
   (b) Discuss the types of surface drainage.
6. Explain the sub-surface drainage method.

Chapter 4

Farm mechanisation

Introduction

A farm is incomplete without appropriate tools and equipment for carrying out various farm tasks and operations. Tools can be defined as implements held by hand to perform a particular kind of work, while equipment may be tools or simple machines like a wheelbarrow or knapsack sprayer.

Tools and equipment should be handled well, maintained and repaired to ensure that they last long and the cost of replacing them constantly will be reduced. This increases the income obtained on the farm because less money is used in acquisition of tools and equipment.

Success criteria

By the end of the chapter, you must be able to:

(a) define the meaning of the term 'farm mechanisation'
(b) list types of farm machinery
(c) explain the factors to consider when mechanising a farm
(d) state the advantages of farm mechanisation
(e) state the limitations of farm mechanisation
(f) describe the maintenance of various farm machinery
(g) discuss safety measures when using farm machinery.

Definition

Farm mechanisation is the use of machines to perform various tasks on the farm in order to improve the productivity.

Machines substitute human and animal power in agricultural production.

Fig. 4.1 Ploughing using a tractor drawn implement

Types of farm machinery

Machines make work easier, save time and are more efficient. Some of the machines that are used in the farm include the following:

- cultivators
- planters and seeders
- milking machines
- sprayers
- harvesting machines

Activity 4.1 Identifying types of farm machinery

(a) Under the guidance of your teacher, visit a mechanised farm to identify the types of machinery being used on the farm.
(b) List the types of machinery you have identified in your notebooks.
(c) Discuss the types of machinery in class.
(d) Collect pictures of farm machinery with well labelled parts.
(e) Discuss the pictures with your classmates.

Cultivators

These are machines that are used for ploughing the land. Primary tillage machines are used for the first breaking of land. Examples of such machines include ploughs, tillers, ridgers and sub-soilers. Secondary tillage machines are used for the subsequent cultivation after primary cultivation to give the seedbed a fine tilth for planting. Harrows are mainly used for secondary tillage.

Ploughs

The three common ploughs used on farms are the mouldboard plough, disc plough and the chisel plough. A plough performs the following tasks:

1. Crushes the soil into fine particles.
2. Aerates and loosens the soil.
3. Mixes organic matter into the soil.
4. Kills weeds and pests by exposing them to the sun's heat.

Mouldboard plough

This is an implement which cuts and turns furrow slices. It is either mounted or trailed by a tractor as shown in Figure 4.2. Mounted ploughs are recommended as they can easily be controlled with the help of the hydraulic system in the tractor.

Maintenance of a mouldboard plough

Proper maintenance of a mouldboard plough includes doing the following.

1. Lubricate the rotating parts of the plough such as the wheel bearing.
2. Keep shares tight and sharp.
3. Keep nuts and bolts tight.
4. When storing the plough over a season, coat it with a rust preventive substance such as oil or grease. Rust proofing is as important as lubrication because rusty mouldboards give bad ploughing, imperfect seedbed, and reduced yields.

Fig. 4.2 Mouldboard plough

Disc plough

The disc plough has a heavy steel concave disc of about 60 – 70 cm in diameter which carries out similar functions as the mouldboard and the share. As the disc plough is pulled along, the discs rotate cutting into the soil and the furrow slice is brought up in the concave discs to be broken up as it is thrown sideways. The disc plough does not produce completely inverted furrows or bury trash and weeds as the mouldboard does. Figure 4.3 shows a disc plough being used on a farm.

Fig. 4.3 Disc plough

Maintenance of a disc plough

To maintain a disc plough, the farmer needs to:

1. Keep the disc bearing clean and properly adjusted.
2. Lubricate the bearing as instructed in the operator manual.
3. Check plough adjustment if the steering is hard.
4. Coat disc blades with rust preventive or used engine oil.
5. Repair broken blades with special welding electrodes.
6. Constantly check for loose nuts and bolts and tighten if necessary.
7. Ensure that the angle of cut of the blade has been correctly adjusted.

Chisel plough

A chisel plough has narrow and double ended shovels that are mounted long shanks as shown in Figure 4.4. It is used to get deep tillage with minimal soil disruption. The chisel plough rips through the soil and stirs it but does not turn the soil over. It is used to break soils that are hard and dry (hardpans).

Fig. 4.4 Chisel plough

Rotary tiller

The most common type of tiller is the rotary tiller. This implement is also known as the rotary shredder, rota beater, hammer knife mower, or rotary cultivator. It works on the principle of high speed revolving blades or hammers which beat and cut the soil together with trash. It is a multi-purpose equipment in that it does the work of both primary and secondary cultivation. Knives or blades move

Fig. 4.5 Rotary tiller

at a high speed at vertical angles to the ground thus cutting the soil. Figure 4.5 shows a rotary tiller.

Maintenance of a rotary tiller

To maintain a rotary tiller, a farmer needs to:

1. Grease the depth wheel, rotor bearing and depth adjuster.
2. Check oil levels in the gearbox daily and weekly for the chain.
3. Straighten bent blades or replace them as needed. Replace or repair broken or damaged blades.
4. Ensure that the bolt holding the blades are always tight.
5. Keep the correct chain tension.

Ridgers

These are mainly used in the cultivation of root crops such as potatoes, and for creating ridges for crops like sugarcane cuttings, maize, groundnuts and tobacco. They heap up soil on the sides of the ridge. They can also be used to create channels for irrigation purposes. Figure 4.6 shows a ridger being used to create channels.

Fig. 4.6 A ridger

Sub-soilers

These are similar to the chisel plough but are heavier and stronger since they are used to penetrate the soil to a depth of 50 – 90 cm. Figure 4.7 shows a sub-soiler in use. They are used to:

1. Burst up the sub-soil.
2. Improve soil drainage.
3. Aerate the soil by breaking the hardpans and clods.
4. Remove deep rooted weeds due to their penetrating ability.

Fig. 4.7 Sub-soiler

Maintenance of sub-soiler

A sub-soiler needs little maintenance. Frequent checks should be carried out on the various parts so that worn out or broken ones are replaced if necessary.

Harrows

Harrows are used to level the seedbed, crush the clods, stir the soil and destroy weeds. They can also be used to cover trash in the soil. Common types of harrows include the disc harrow, spring tine harrow and the spike tooth harrow.

Disc harrow

Disc harrows are either plain or notched. Plain harrows have smooth cutting edges on the discs while the notched harrows have grooves in the cutting disc plate as shown in Figure 4.8. Harrows comprise a number of sets of gangs of concave discs which can be set at variable angles to the direction of movement. A gang is an assembly of discs all rotating together with a common shaft or bolt through their centres. A disc harrow turns and breaks down the soil surface. It also mixes the plant remains into the soil. It is suitable for use on light soil.

Fig. 4.8 A notched disc harrow

Spring tine harrow

This is made of spring steel with replaceable steel digging points. It is similar to the chisel plough in shape but is not as heavy. The frame in which the tines are mounted touches the ground level while in operation as seen in Figure 4.9. The vibrating tines break the soil clods while the frame tends to level the ground. The spring tine cultivator can be used for shallow work. It is convenient for inter-row cultivation and hence can be used in weeding operations. It is capable of crushing the soil and is therefore ideal for incorporating soil chemicals.

Fig. 4.9 Spring tine harrow

Spike tooth harrow

The spike tooth harrow is mounted on either heavy metal or a wooden frame. It has spikes which resemble the chisel. See Figure 4.10. It is useful in preparing a fine level seedbed. The harrow is pulled by a tractor, as it levels the surface and breaks the clods.

Fig. 4.10 Spike tooth harrow

Maintenance of harrows

1. Replace or tighten loose parts such as missing pins, nuts and bolts.
2. Check for broken or bent frames. Broken frames should be welded. Broken blades, springs and spikes should also be repaired or replaced depending on the extent of the damage.
3. Grease the disc bearing daily when in use.
4. Coat with oil after a work season to prevent rust.

Planters and seeders

These are machines that are used for sowing or planting seeds in cultivated fields. Planters, also known as drillers, consist of two boxes called hoppers, carried on wheels, from which seeds and fertilisers are discharged through feed mechanism. This is the method through which seeds are dropped on the ground from the planters. The seeds pass through a delivery tube into shallow furrows made by coulters. A coulter is an iron implement which cuts furrows in which the seeds and fertilisers are dropped. The depth of the furrow can be adjusted by adjusting the coulters. At the end of the run, the coulters are lifted off the drive and the feed mechanism is cut off, to prevent seeds and fertilisers from dropping. The press wheel then covers and presses the seeds into the soil.

Fig. 4.11 A planter

Maintenance of planters

1. Greasing and oiling the movable parts should be done regularly.
2. The bolts and nuts should be checked to ensure they are tight.
3. The planters should be cleared and coated with an anti-rust substance after the sowing season and before storage.

Sprayers

These are machines for spraying liquids on crops or animals. Usually the liquid is water mixed with a chemical which is used for pest control in animals and crops. These machines range from simple hand operated machines to complex tractor operated systems. Very many sprayers are in the market, but all of them work on the same principles.

Fig. 4.12 A farmer using a knapsack hand sprayer on his crops

Hand syringe knapsack sprayer

These have a double acting syringe system which allows for continuous output of liquids in droplets when spraying crops or animals. They are economical and will usually hold 5 – 20 litres of liquid. However, they are tedious and slow – 5 hours per hectare. The rate of work is dictated by the speed of pumping and the walking pace of the operator.

Hydraulic sprayers

They are more expensive compared to hand sprayers, but they are less tiring to operate and can be used on large farms such as coffee plantations and orchards. A sprayer boom can be attached to the sprayer to increase the rate of work when spraying crops on large farms. A boom has more than one nozzle attached to it.

Fig. 4.13 Hydraulic sprayer with a boom attached to it

Tractor operated sprayer

A tractor operated sprayer consists of a tank for holding the chemical, a pump for providing the pressure to spray and a boom for holding the nozzles which release thin films of the chemical.

A boom holds nozzles at a suitable distance. They can either be at fixed or varied lengths if carried by a number of people along the tractor.

Fig. 4.14 A tractor operated sprayer

After filling the tank with the spray liquid, the spray boom is set at a right angle and 40 cm above the target. Spraying should not be carried out on windy days to prevent the chemical from being blown away as this might be harmful to other crops and non-targeted objects.

Maintenance of sprayers

1. Clean and wash all parts after use. Store the sprayer in a clean dry place. This is useful as most chemicals corrode the metal parts.
2. Extra care should be taken on nozzles to ensure they are clean and that all the openings are not blocked.
3. Always filter off all dirt in the spray-liquid as it can easily block the nozzles.

Harvesting machines

Crop harvesting can either be done by hand or machines. Hand harvesting is normally done on small scale farms. Root crops can be harvested using hoes and animal-drawn implements. Care should be taken to avoid damage to the root crop. The equipment for lifting potatoes and other root crops is ideal for large scale production. The choice of the lifting equipment will depend on the soil conditions, the size of the land, and the capital available to buy the machine.
Below are the common machines used for harvesting.

Forage harvester

A forage harvester is a machine-driven equipment mainly used to gather fodder. It cuts, chops and loads the fodder onto a trailer. It has a rotor with 2 – 4 thrashers. The thrashers shear off the crop as the harvester moves. The cut material is collected through the chute which delivers it onto the trailer.

Fig. 4.15 Forage harvester

Combine harvester

The combine harvester is mainly used in large scale operations for harvesting cereal crops. It is capable of sorting out the grain from the chaff and straw, hence the name combine harvester. The machine has the following parts:

- Outer bar assembly height – This gives the height at which harvesting is done in relation to the ground level. It also determines the amount of straw to be handled at the set speed.

Fig. 4.16 A combine harvester

- Pick-up reel – This should be set to assemble the heads, cut and feed them into the conveyor chute.
- Straw walker – Its function is to separate the grains from the straw.
- Grain sieve – This is used to remove the grains from the chaff. The size of the sieve depends on the type of grain being harvested.

Potato lifting plough

A potato lifting plough is composed of a flat share fitted with steel prongs which furrow and lift the tubers from the soil. The depth is controlled by the tool bar depth wheels which follow the tractor wheels. The lifting tools must be set to run exactly along the centres of the rows.

Fig. 4.17 Potato lifting plough

Potato digger

The potato digger consists of a broad share behind which rises a metal elevator chain with parallel links. When operating the potato digger, the point of the share must be set to run accurately in the centre of the row and work beneath the potato roots. The soil is shed off through the chain web, and the potatoes are delivered at the rear of the machine.

Fig. 4.18 Potato digger

Sheller

Maize is one of the crops which require shelling after harvesting. This is the removal of the grains from the cob. In small scale farms, shelling is done by hand. However, the task of shelling by hand is not easy and takes long. Mechanical shellers, which are either power driven or hand-operated, are more ideal. Some power-driven maize shellers are fitted with fans for cleaning, and a sieve for separating the grains from the husks and pieces of cobs.

Fig. 4.19 Farmers using a motorised maize sheller

Maintenance of harvesters

1. All the guards, blades, bolts and nuts should be in place and fitted correctly before doing any work with the machines.
2. The machines should be cleaned regularly to remove straw and chaff that have been deposited in the engine, around the belts and the grain sieve.

Milking machines

These are machines that are used by farmers during the milking process. This machine is used to extract milk in livestock, especially cows, using a vacuum. The milk is then deposited in a container. This machine causes minimal damage to the teat and the milk is free from dangerous pathogens and micro-organisms. The machine also reduces the occurrence of mastitis in cows.

Fig. 4.20 A cow being milked using a milking machine

Maintenance of milking machines

1. The vacuum regulator should be checked constantly to ensure that it is operating properly.
2. The pipes should be checked regularly to ensure that no air is leaking through them.
3. Clean the machine and vacuum regulator always.
4. Service the machine after every six months.

Factors to consider when mechanising a farm

There are various factors to consider when mechanising a farm. These include:

- Size of the farm.
- Costs of farm mechanisation.
- Efficiency and speed of the machines.
- Availability of labour.

1. Size of the farm

Before mechanising a farm, the size of the farm should be considered. A large farm will require more machines than a small one which can be operated using small machines. For instance, a large maize field can be harvested using a combine harvester whereas maize grown on small scale can be harvested manually and shelled using a sheller.

2. Costs of farm mechanisation

The costs that will be used in mechanising a farm should be calculated. These include the costs of acquisition of the farm machines and the costs of maintenance of the machines. These should be identified before mechanising a farm.

3. Efficiency and speed of the machines

The efficiency and speed of the machines should be considered. How fast a machine works should be determined to know the amount of output that should be obtained within a specified period. The machines should also be efficient in that they can be used even under severe weather conditions.

4. Availability of labour

The farmer should determine if there will be efficient and skilled labour that will be used in operating the machines well to prevent damage and reduce accidents occurring on the farm.

Activity 4.2 Discussing factors to consider when mechanising a farm

(a) Form groups of five. In your groups, list the factors to consider when mechanising a farm.
(b) Discuss the factors in your groups and take down notes during the discussion.

Advantages of farm mechanisation

Farm mechanisation has the following benefits to a farmer:

1. The speed of operation is faster and more work output achieved.
2. The machinery can be controlled to prevent contamination of products. For instance, using a milking machine prevents the build-up of bacteria.
3. Mechanisation enables a farmer use new and improved farm technology which is time saving in agriculture.
4. The demand for manual labour is usually high when carrying out various farm operations. However, a farmer who uses farm machinery will have the operations done in a timely manner without relying on manual labour.
5. On a large scale farm, mechanisation is cheaper and efficient thus a farmer is able to attain maximum profits from the farm produce obtained.
6. There are activities which cannot be achieved easily when they are carried out manually. These include farm transport or processing of farm produce. Through farm mechanisation, these activities can be carried out effectively on the farm.

Limitations of farm mechanisation

1. Mechanisation requires trained operators not only for safety but also for general operations and proper handling of the machines.
2. Mechanisation is usually ideal on commercial and large scale farms because it is costly to small scale farmers when it comes to acquisition of the machines. Maintenance and

operational costs such as fuel and electricity may not be affordable to small scale farmers. In some rural areas, there is no electricity.

3. Mechanisation leads to unemployment in areas where human labour is abundant and cheap such as in the plantations.

Activity 4.3 Researching on advantages and limitations of farm mechanisation

a) During your free time, visit a nearby farm that is mechanised.

b) Find out from the farmer the advantages and limitations of farm mechanisation.

c) Write down short notes in your notebooks.

d) Discuss your findings in class.

Safety measures when using farm machinery

While a lot of emphasis has been put on the care and maintenance of farm tools, it is also important to stress that safety of the operator of the machine and other farm employees is of utmost importance.

The following safety measures should be taken when handling farm machinery.

- Wear appropriate clothing for the work such as overalls, masks and gumboots. Avoid putting on loose clothes or any other items which might get entangled in machines when they are in use.
- Farm chemicals should be handled, stored, used and disposed of as recommended to avoid poisoning or pollution of the environment. Wash the machines used for spraying, dry them and keep them out of the reach of children.
- Farm implements and machines should be used only after the instructions have been read and understood. Always use the right machine or implement for the job it is to perform.
- Blades which require sharpening must always be kept sharp. The use of blunt cutting blades when using machines may cause injuries and also slow down the rate at which the work is supposed to be done. In addition, the desired results will not be achieved due to inefficiency.
- Care should be taken when using electrical equipment to prevent electrical accidents and fires.
- Farm workers should be trained in skills of lifting equipment to prevent back injuries. Only skilled and trained people should be allowed to handle the machines to reduce accidents.
- All machines should be kept safely, and the entries to the buildings and other structures should be clear of tools, equipment and other pieces of waste which might cause accidents.

Fig. 4.21 An appropriate storage structure for farm machinery

- A fire extinguisher is a vital equipment in the farm and it should be kept in an accessible place and should be operational. It is necessary to keep all entrances clear for ease of access and exit.
- Do not smoke, eat or drink while spraying. Wash your hands well after spraying and before eating.

Since accidents still occur on the farm occasionally, in spite of the efforts made to prevent them, every worker needs to know what to do in case of an emergency. The value of knowledge in First Aid must not be underestimated as it can save a life.

Activity 4.4 Discussing safety measures when handling farm machinery

(a) In groups of five, research and discuss the safety measures that can be taken on a farm when handling farm machinery to reduce the number of accidents occurring on the farm.

(b) Your teacher will demonstrate to you the safety measures undertaken when handling farm machinery.

(c) Practise some of these safety measures on any machines available in your school farm.

Practical activities

1. Carry out a survey to identify the types of machinery used by farmers in Malawi. Use your local area as a case study. These should include:
   (a) Cultivation machinery
   (b) Planting machinery
   (c) Spraying machinery
   (d) Harvesting machinery
   (e) Animal production machinery
   (f) Crop processing machinery

2. Interview farmers to find out how the machines found in their farms have contribute to the development of agriculture in the area.
3. Write a report on the study and give recommendations on the ways to improv machinery use.

Summary

- Mechanisation is the use of machines instead of using hands to perform work in the farm. Machines make work easier, save time and are more efficient.
- The most commonly used implements in primary cultivation include the ploughs, tillers and sub-soilers.
- The three common ploughs used on farms are the mouldboard plough, disc plough and the chisel plough.
- Sub-soilers are used to break soil hardpans and clods, burst the soil, improve drainage, aerate and remove deep rooted weeds. The sub-soiler can also be used in operating irrigation channels for piping and laying underground electric cables.
- Rotavators are multi-purpose equipment that are used in both primary and secondary cultivation.
- Secondary cultivation involves the use of harrows.
- Planters and seeders are machines used for sowing seeds into the field.
- Sprayers are machines for spraying liquids on crops or animals. They range from simple hand operated to complex tractor operated systems.
- Crop harvesting can either be done by hand or machines. Hand harvesting is normally done on small scale farms.
- The common tools for harvesting include sickles, machetes and knives, mowers, forage harvesters and combine harvesters. Root crops can be harvested using hoes and animal-drawn implements.
- Animal-drawn implements derive power to do work from animals. Although ox-implements are common, many other animals like donkeys, horses or even dogs are used in many parts of the world.
- While a lot of emphasis has been put on the care and maintenance of farm tools, it is important to stress that safety of the operator and other farm employees is of utmost importance.

Revision questions 4

1. Define the term 'farm mechanisation'.
2. What are the factors a farmer may consider when choosing farm machinery.
3. (a) Outline the benefits of farm mechanisation.
   (b) Explain the limitations of farm mechanisation in your local area.
   (c) Outline the categories of agricultural machinery.

Chapter 5

Farm power

Introduction

All work done on the farm requires application of energy. We use energy stored in our bodies to do work on the farm such as digging, planting, milking, harvesting and weeding. There are different sources of power that are used in the farm. It is important that a farmer identifies the best farm power to use in accomplishing various tasks on the farm at a low cost.

Success criteria

By the end of the chapter, you must be able to:

(a) describe sources of farm power

(b) describe the advantages of different sources of farm power

(c) describe the limitations of different sources of farm power

(d) state ways of improving output from the different sources of farm power.

Sources of power

On the farm, we have various sources of power. These include:

- Human
- Animal
- Wind
- Mechanical
- Water
- Solar
- Biogas

Human power

Human power is the most important and widely used source of energy on the farm and may be referred to as labour. This is because it is resourceful as it can be used anywhere and at any time on the farm. Human beings have a managerial and thinking ability which enables them to control the other sources of power. However, human power is slow since it is basically manual. Only healthy human beings and those trained in certain fields are able to carry out activities on the farm effectively and efficiently.

Fig. 5.1 Human power used in harvesting tea

Human power can be divided into two categories:

(a) Family labour – This is provided by the family members. It is the most readily available source of labour in subsistence farming in most societies. Its efficiency depends on the following factors:
- Technical know-how – Efficient human input requires technical know-how. For example, when milking dairy cows, the person doing this should know how to milk well.
- The number or size of the family and their respective ages determine not only the quality of work but also the amount of work done within a given time.
- The attitude and determination of the members to carry out the desired tasks.

(b) Hired labour – In most commercial farms, labour is in the form of contracts, casual workers or permanent employees.

Advantages of human power

1. It is easy to manipulate human power since the number of people working on a farm can be reduced or increased depending on the amount of work available at a particular time.
2. Human power can be used to manage and control other sources of power. For example, animal power requires the input of human power.
3. Human power can be from the farmer himself/herself and hence the farmer can determine the direction of operation as need arises.

Limitations of human power

1. It is not easy to estimate accurately the amount of output produced by each person, especially if there are many people working on a farm.
2. The availability of human power at the time of need may not be guaranteed. For example, a farm worker may fail to turn up for work without prior notice or they may fall sick.
3. There is a limit to the amount and type of work that human power can accomplish with efficiency.
4. The amount of work done depends on the health, attitude and physical ability of the worker.

Ways of improving human power output

The following may be carried out to improve human power output.

1. Provide the people offering the labour services with efficient tools for working. The tools should be maintained frequently to reduce accidents. Human labour is not only slow and tedious but less efficient. The use of machinery enables faster and efficient labour output.
2. Human power on a farm should be highly skilled. Those who do not have the required skills should be trained and educated on various agricultural practices that will help

to increase productivity on a farm. They should also be educated on how to handle various machines and implements on the farm.

3. Motivation of human power is very important in improving the output from a farm. Therefore, human power should be provided with good working conditions to ensure high productivity. The wages can also be increased often to motivate the workers even more.
4. Unsupervised labour may lack direction. It is proper to identify the amount of work over a given time. Records of attendance and conduct of workers are indications of the amount of work done under the control of management.
5. Let each farm worker know what is expected of him or her in the work place. Where possible, consider age, qualification and gender issues when assigning duties.
6. The work place should facilitate work output and ensure good health.
7. Give equal pay for equal work to ensure fairness.
8. Where the workers are housed nearby, provide facilities for leisure, exercise and health.

Activity 5.1 Discussing the sources of farm power

(a) In groups of five, list the sources of farm power that are used by farmers in your local area.
(b) Discuss human power and identify the categories of human power.
(c) List the advantages and limitations of human power.
(d) Suggest ways of improving the output from human power. Take down note during the discussion.

Animal power

History shows that animals such as horses, donkeys, oxen, mules and camels have f hundreds of years been used as a source of power for farm work. They have been used cultivation, transportation, and even driving some machinery.

The ox

The ox is the most widely used animal as a source of farm power. Oxen mostly used in operating ox-drawn implements such as ploughs in cases where a farmer does not have modern machinery such as tractors.

Fig. 5.2 Oxen being used during ploughi

Advantages of the ox as source of animal power

1. The ox is generally hardy, strong and easy to feed.
2. It is cheap to buy and to maintain even by small scale farmers.
3. Little skill is needed to operate ox-drawn implements.
4. At the end of the working life of the ox, it may be sold for meat after fattening.

Limitations of using the ox as a source of animal power

1. Some oxen may not be friendly hence may cause danger to the operator or the public.
2. Oxen require adequate grazing land which may not be available due to population pressure.
3. It is difficult to train the ox for farm work. The ox requires human power to operate efficiently and this may not be readily available.
4. The speed of work of oxen is very slow.
5. Prevalence of diseases and parasites affects the health of the animals especially when there is an outbreak. The animals may die if not treated on time or they may be too weak to work.
6. For cultivation purposes, the ox works well on light soils, and does not work efficiently on heavy soils.

The donkey

The donkey tends to be friendlier once trained for the work, hardy and is generally meek. It is mostly used for transportation purposes or for carrying loads around the farm. It can also be used for ploughing if a farmer does not have oxen.

Fig. 5.3 A donkey being used for carrying loads

Advantages of using a donkey

1. It is cheaper to buy, rear and maintain than the other farm animals.
2. It is easy to train a donkey for work and it responds fast to commands such as "lie down" to pick a load. It is patient when given the right amount of work.

Limitations of using a donkey

1. It cannot carry very heavy loads and works for a few hours.
2. It works much slowly and gets tired if overworked or driven too fast.

3. It is susceptible to trypanosomiasis and hence requires protection from tsetse flies.
4. Constant whipping of a donkey easily leads to sores and wounds which may be a habitat for parasites thus may lead to the death of the donkey.

The horse

The horse is more likely to be found with the upper-class farmers. It is usually given more care than the other farm animals like the donkey or the ox. However, in some areas it is generally popular for sporting activities than for farm work.

Horses provide transport services to a farmer. A carriage is fixed on their backs and controlled by the farmer to determine the speed of their movement. Therefore, horses can be used in transporting farm produce to the market on time. In Malawi, they are not widely used for agricultural purposes since most farmers are small scale farmers who cannot provide the high care and maintenance needed.

Fig. 5.4 A horse being used for transportation on a farm

Advantages of using farm horses

1. It is a friendly animal which develops attachment to the owner.
2. It does the job much faster than other farm animals.
3. It is easy to handle, docile and can be controlled easily and accurately.
4. The horse can be trained to perform various tasks on the farm.

Limitations of using farm horses

1. Under the tropical conditions, the horse does not reach the maximum required growth weight.
2. It has a generally weak body conformation; hence it requires proper care and attention.
3. Just like the donkey, it is also more susceptible to trypanosomfasis.
4. The horse cannot work for long hours continuously as it gets tired quickly.
5. It is generally expensive to buy and rear a horse, hence its availability on farms is quite limited.

Advantages of animal power

1. More heavy work can be done by animals than by humans.
2. Animal power is generally cheaper than machinery power such as tractor generated power.

3. Animals can work conveniently on narrow pieces of land.
4. Using animal power does not require specialised skill as is the case with mechanical power where specialised training and licenses or permits to operate the machinery are required.
5. Animals provide valuable dung for biogas and farmyard manure. When the animal can no longer be used as a source of power, it can be slaughtered for meat or sold for cash.

Limitations of animal power

1. There is need for adequate grazing land, which is limited in some places due to population pressure.
2. Animals are prone to diseases and parasite attacks that either kill the animals if not treated or reduce their ability to perform.
3. Animal power requires suitable weather conditions. For example, under high temperatures, the animal power output will be severely reduced.
4. Animals require time for grazing and resting hence do less work than engine power.

Ways of improving animal power output

For efficient and maximum power output from animals, the following factors should be considered:

1. Treat and handle the animals humanely; do not cause injuries to the animals or overload them.
2. The working environment must be suitable and without obstacles or objects which might hinder efficiency of work produced or injure the animals.
3. Animals are keen learners of verbal instructions or visual gestures. This is more ideal than using the cane or the whip to push the animals to work.
4. The animals should be well fed and in good health for efficient power output. Provide adequate and nutritious feed to the animals. Keep the animals healthy by treating sick ones, controlling parasites and offering vaccinations to prevent diseases.
5. Match the animals equally when working, that is, do not yoke a huge ox with a young or smaller one as this creates imbalances on workload distribution.
6. The working equipment must ensure the safety of the animal.
7. Handle the animals gently and allow enough rest periods after work before feeding them. For example, oxen should rest for sometime after farm work before starting to graze.
8. Pay attention to the hooves of the animals. Long hooves often lead to injuries, hinder fast movements, and are a predisposing factor for foot-rot.

9. The animals should be provided with proper housing to protect them from harsh weather conditions and attack by predators or from being stolen.

Activity 5.2 Observing animal power

(a) Visit a farm near your school and observe the sources of animal power that are used on the farm.
(b) Ask the farmer the various tasks performed by each animal on the farm.
(c) Record your findings in your notebook.
(d) Outline the advantages and limitations of each source of animal power that you observed on the farm. Suggest ways of improving the output of animals as a source of power.

Wind power

Wind power is converted and used in wind turbines to produce electrical power. A farm that uses wind power for electrical power production must have large turbines which are connected to the electric power transmission network. Wind power is mostly used to pump water using wind pumps. Windmills provide mechanical power. While wind power is quite useful on the farm, its use cannot be controlled and it may not be available when needed.

Advantages of wind power

1. Power is generated at a very low cost.
2. It is generally easy and cheap to maintain.
3. It is a clean source of power that can be relied on even in future as it does not cause environmental pollution or global warming.

Limitations of wind power

1. The initial cost is relatively high depending on the size of the windmill or wind turbines to be used.
2. The working of the windmill is controlled by the motion of the wind to which the farmer has no control.

Ways of improving wind power output

1. The wind turbines should be placed vertically to increase the output of power.
2. The turbines should be placed close together to ensure maximum utilisation of wind.
3. When constructing windmills, higher towers should be constructed so that a high amount of wind is utilised to increase wind power output.

Activity 5.3 Researching on the uses of wind power on the farm

(a) In pairs, carry out research in the school library of the various uses of wind power on a farm. Discuss this with your partner.

(b) List the advantages and limitations of wind power. Take down notes during the discussion.

Mechanical power

Fig. 5.5 Using the spraying machine to spray herbicides on crops

Besides human and animal power, there is the mechanical power which is also used on many farms. Mechanical power is the power generated by machines. These are machines that are driven by wind power, water power, biogas, fossil fuels and electricity. Mechanisation plays a major role in commercial farming. In large scale farms, about 30 percent of the total cost of production is on farm machinery and equipment. Depending on the size of the farm and nature of farm activities, the farmer has the option to choose the type of suitable power source.

Advantages of mechanical power

1. Use of mechanical power has led to an increase in agricultural production.
2. An increase in agricultural production has in turn led to rural development due to emergence of industries for processing the agricultural produce.
3. Use of machines on the farm has encouraged farmers to start practising agriculture on a large scale.

Limitations of mechanical power

1. The use of mechanical power leads to unemployment of people, especially those who are unskilled.
2. The use of machines on the farm for agricultural production leads to environmental pollution.
3. The heavy machines used to provide mechanical power destroy the soil structure leading to soil degradation.
4. Mechanical power has led to a rise in deforestation. This is because people want more agricultural land so that they can practice large scale farming. This also leads to an increase in soil erosion due to lack of forests and forest cover thus causing soil degradation.

Ways of improving mechanical power output

1. Educate and train machine operators on how to handle and use the machines effectively so that damage is not caused during use.
2. Practise frequent maintenance of the machines to ensure that they last longer and that they perform effectively.
3. Use each machine according to the purpose or function that it is meant to perform.

Activity 5.4 Discussing mechanical power on the farm

(a) In groups of five, list the examples of mechanical power used on a farm.
(b) Discuss the advantages and disadvantages of mechanical power on the farm.
(c) Suggest ways of improving the output of mechanical power on the farm.
(d) Present your findings in class.

Water or hydro-power

Water power, like wind power, cannot be controlled easily due to the unreliable water availability which is dependent on weather. Hydro-electric power can be used to drive grinding mills or other machines and to produce electricity.

Water power production depends on two factors:

- the volume of water flowing per minute
- the height or vertical distance at which the water drops from to the point where the power installation is located.

Hydro-electric power is obtained through the construction of a dam across a river. The electricity is typically created when the water is passed over large mechanical turbines. The water pressure forces the turbines to turn and the mechanical energy created is then converted into electricity.

The power generated is used in homes and on the farm for lighting and in running various machines on the farm. Water power generation is expensive and requires heavy financial investment. It also needs technical skills to operate and maintain. The power generated depends on the flow of water.

Fig. 5.6 Kapichira hydro-electric power station in Malawi

Advantages of water power

1. Water is used but it does not reduce in quantity.
2. It is produced all the time as long as the source or body of water does not go dry.
3. There are no waste products during the prodution of electricity.

Limitations of water power

1. A power plant is very expensive to construct.
2. The source of power is dependent on water and thus cannot produce power when the levels of water are very low.
3. The water used in generating power is also used for domestic purposes. It is also used in industries and this makes the levels of water to go down significantly. Therefore, the amount of water power produced is very little.

Ways of improving water power

1. Replace old turbines with new ones to increase power output.
2. Shut the outlets of the dam to prevent water flow so as to conserve the water for use when the demand for water power is high.

Activity 5.5 Visiting a water power station

(a) Your teacher will organise for you a visit to a water power plant. During the visit, find out how water is used to generate power.
(b) Write down short notes in your exercise books during the visit.
(c) Draw an illustration to show the process of power generation using water.

Solar power

This is the energy from the sun. It is very abundant in the tropical regions of the world yet the least used. Solar energy is ideal for heating and drying of agricultural produce on the farm as well as for lighting. Under natural farming conditions, solar power enables the green plants to manufacture their own food through the process of photosynthesis. The sun's rays with wavelengths ranging from 400–700 mm are absorbed and changed into energy to manufacture plant foods. The energy is also used in drying plant products such as grains before storage and subsequent use. The sun is essential for the life and growth of plants and health in animals.

Fig. 5.7 A solar powered watering system for livestock on a farm

As a source of power on the farm, solar energy is trapped from the sun's rays using solar panels and stored in solar batteries.

Advantages of solar power

1. It is cheap and easy to install.
2. It can be used to supply electricity to homes and drive electrical machines like water pumps.

Limitations of solar power

1. It depends on the sunshine's intensity and its duration, over which a human being has no control.
2. The storage equipment for solar power tends to be generally expensive.
3. It requires qualified technical know-how for maintenance and this may not be easily available in the rural areas.

Ways of improving solar power output

1. Buy durable and effective solar panels that will be used in absorbing more energy from the sun.
2. Installation of the solar panels should be done appropriately.
3. Solar concentrators should be used to concentrate the energy from the sun to the solar panels. Large mirrors can be used as solar concentrators.

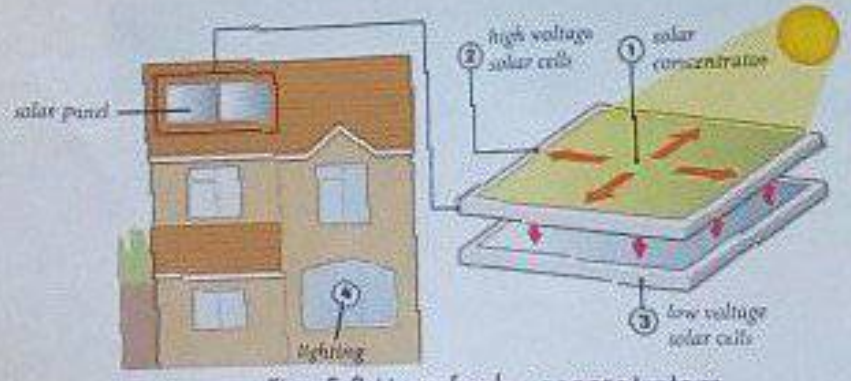

Fig. 5.8 Use of solar concentrators

4. The solar panels should be placed in open areas where there is no shade so that the maximum amount of energy from the sun reaches them.
5. Avoid accumulation of dust on the panels. The presence of dust reduces the efficiency of the solar panels.

Activity 5.6 Visiting a solar powered farm

(a) Under the company of your teacher, visit a solar powered farm.
(b) Find out from the resource person at the farm what the solar power is used for on the farm.
(c) Let them tell you the advantages and disadvantages of solar power.
(d) Find out from them how they improve the output of the solar power.
(e) Take down notes in your notebook.

Biogas

Biogas consists of a mixture of gases. These gases are produced when organic matter is broken down. This is normally in the absence of oxygen. On a farm, biogas can be derived from livestock dung and droppings. The dung and droppings decompose through biochemical reactions. This process changes the decomposing organic matter to carbohydrates, sugars, volatile acids and eventually to biogas. Biogas produces good quality manure as a by-product.

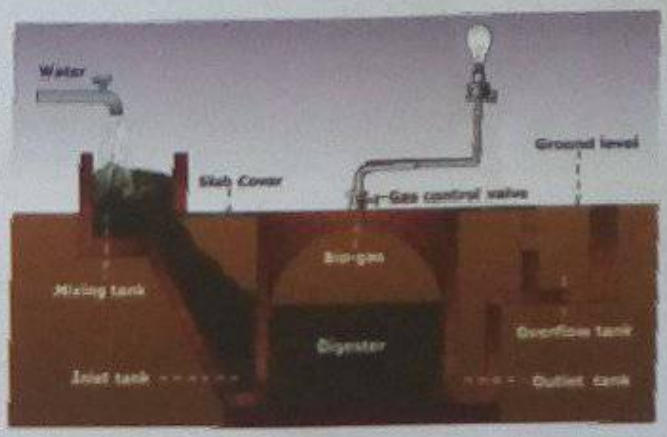

Fig. 5.9 A biogas digester

The biogas equipment can be made of local materials. The facility has the following components:

- digester tank
- gas collector assembly
- inlet and output pipes.

Advantages of biogas

1. It is the cheapest source of power to run after the initial cost.
2. Maintenance requirements are simple and include mainly cleaning.
3. The by-products of fermentation provide high quality manure.

Limitations of biogas

1. The initial cost of installation may be prohibitive to some farmers.
2. It requires constant supply of organic materials including cow dung. Therefore, maintenance of animals is an essential requirement for biogas production.

Ways of improving biogas output

Use of other waste products such as sewage and industrial wastes should also be made to avoid overdependence on animal waste only.

Chapter 6

Gender and agricultural technology

Introduction

Provision and access to new technology is of significance in maintaining and improving agricultural productivity. However, there exists gender related gaps in a wide range of agricultural technologies including farm machinery, improved plant varieties and animal breeds, fertilisers, pest control measures and management techniques. Besides other constraints and limitations, these gaps lead to gender inequalities in accessing and adopting new technologies in African countries, Malawi included.

In most developing countries, development in the field of agriculture stagnated. This may is attributed to gender bias in the development of agricultural technology. Women contribute to a big percentage of work. This means that technological development in this field must take into consideration the role of women to ensure women-friendly technology is developed.

To ensure that there is improved agricultural production, appropriate technologies need to be embraced in agriculture. Cheaper and efficient ways of water supply must be developed. Fuel-efficient stoves should also be used to reduce the time spent by women looking for firewood. This will allow them more time for agricultural production. It will also prevent soil degradation as deforestation practices will reduce. One way is to practice extensive agroforestry which will help reduce time spent searching for firewood.

Improved extension services are also important in diffusing technology and good practices but these must reach the female farmers too.

Success criteria

By the end of the chapter, you must be able to:

(a) identify gender biases in agricultural technology
(b) explain causes of gender biases in agricultural technology
(c) examine effects of gender bias in agricultural technology
(d) describe ways of dealing with gender bias in agricultural technology.

Gender biases in agricultural technology

There are traditional roles which hinder effective contribution of women to agricultural production yet they are the main players in the agricultural field. Women take care of children and are thus locked out of regular wage employment. Women spend more time on household chores including food preparation, collection of firewood and water. This

hinders their active participation in agricultural production. They are left to perform minor agricultural duties or to just practise subsistence farming.

Gender equality in agriculture technology will lead to:

- reduction of rural poverty
- improved food security
- improved health and nutrition
- sustainable management of natural resources.

Fig. 6.1 Women working on a farm

The above have not been achieved due to gender biases in agriculture. The biases in agricultural technology include the followin.:

1. There are very few friendly farm tools and equipment for women to use and handle while working on the farm. There is no particular farm technology that can be used by all the genders. Each technology is, designed for a specific type of gender, that is either for the men or for women. Many tools used on the farm are either too heavy or require a lot of effort for women to be able to operate them.

Fig. 6.2 A woman tilling the land using a hand tool

2. In Malawi, women are given hand tools to perform various tasks such as transplanting, weeding, planting and threshing whereas the complex machine and technologies are left to the men. It is assumed that women cannot be able to use these machines.
3. Heavy machinery and equipment which are mostly used in large scale farming are only operated by men. Therefore, women do not play a major role in large scale agricultural production since they lack the technical know-how of operating the machines or equipment. Women are therefore left to carry out activities such as processing of farm produce.

Fig. 6.3 A man being taught how to operate a tractor

4. Women involved in agricultural production have limited access to finances. They are therefore unable to acquire most agricultural resources.
5. Seminars and technical courses that are organised to provide education and training on how to use various agricultural technologies are sometimes organised in distant areas where women may not be able to go. This is because they have other chores around the home that they need to perform and thus they are often left out. This therefore favours the attendance of men only and very few women if there are any.

Activity 6.1 Discussing gender biases in agricultural technology

(e) In groups of five, discuss gender biases in agricultural technology that are experienced in your local area.
(f) Write down short notes during the discussion and present your findings in class.

Causes of gender biases in agricultural technology

Gender discrimination is a prejudice based on a person's sex or gender. Women in agricultural production are usually victims of gender biased decisions ranging from technology to provision and access of resources. The causes of these biases include:

- There exists a history of inequality among sexes in the African society which leads to the foundation of inequality. Women are generally unrepresented in the work place, social functions and academics. The consequences of favouritism towards men and unfair treatment of women is the main cause of gender bias in agricultural technology.
- Gender stereotype and tendencies in which men are seen as more socially valued than women lead to failure to provide appropriate farming technology to women in the belief that women are incapable of handling technical issues.
- Physical factors in which women are perceived to be weaker than men are extended to technologies in which women are discriminated in using heavy machinery.

Activity 6.2 Researching on the causes of gender biases in agricultural technology

(a) Interview some farmers in your local area on what causes gender biases in agricultural technology. Ensure that you interview both men and women.
(b) Take down notes during the interview.
(c) Discuss your findings in class.

Effects of gender bias in agricultural technology

Some of the effects of gender discrimination lead to hostility in the work environment and resistance to adoption of new ideas and technology.
Failure to incorporate women in adopting technological change leads to:

(a) Loss of efficiency in farming practices and thus a decline in agricultural production, especially in the rural areas.
(b) Reduction of women's household bargaining power and increased labour.
(c) A decrease in the production level in women-dominated areas of agricultural production and increased production in the men-dominated areas of production, reducing women to a source of cheap labour or casual workers.
(d) An increase in food insecurity due to low productivity. This is because 70% of the agricultural production industry is dominated by women. This will also lead to malnutrition since the food produced will not be able to feed the entire population.

Activity 6.3 Debating the effects of gender bias in agricultural technology

(a) In class, debate on the following motion: 'Gender bias in agricultural technology leads to low agricultural production'.
(b) Come up with the future effects of gender bias in agricultural production. Draw a wheel to represent the effects on a chart and display it in class.

Dealing with gender bias in agricultural technology

1. There is need to target women in the extension services provided by extension officers.
2. People living in the rural areas should be provided by the government with inputs such as seeds and fertilisers to be used for agricultural production.
3. There is need for inclusion of women in making community development decisions and avoid exclusion. Women should also be involved in agricultural production policy formulation.
4. Economic and policy reforms must consider women too because they do more farm work as opposed to men who are often in higher or managerial positions.
5. Reductions of drudgery in farm work and provision of better education opportunities for women are among the key remedies to gender bias. Societies that have paid more attention to women's education have progressed in different fields including adoption of modern agricultural technology.
6. Stereotyping should be stopped so that women can also be trained to operate the heavy machines that are used in agricultural production.

Practical activities

1. Visit different farms with modern agricultural technology and investigate who uses which tools or machines on the farms.
2. Tabulate your findings in your notebooks.

Chapter 7

Improved farming technology

Introduction

Improved farming technology is crucial in maintaining and improving agricultural productivity. The ranges of improved farming technologies include farm machinery, tools and equipment, improved crop varieties and animal breeds. Use of fertilisers, organic manure, pest control strategies, irrigation and improved farm management practices lead to an increase in agricultural production. Adoption of new technologies in farming can be referred to as improved farming technology.

Success criteria

By the end of the chapter, you must be able to:

(a) explain the meaning of the term 'improved farming technology'

(b) explain how improved farming technology increases food supply

(c) explain how farming technology affects food security.

Definition

Technology is an art or skill of hand. It involves the making, modification, usage and knowledge of tools and machines. It can further be referred to as methods of organising activities and ideas to solve a problem or improve the old approaches of solving problems. Improved farming technology refers to the use of new and better machinery/equipment to improve livestock and crop production. It also involves the application of scientific knowledge in agricultural production.

Classification of technology in farming

There are two classes of technology that are used in farming. These include:

- improved farming technology.
- unimproved farming technology.

Activity 7.1 Observing examples of farming technology

(a) In groups of five, classify technology into improved and unimproved technology.

(b) List examples of farming technologies in each category.

(c) Observe various types of farming technologies in magazines and pictures.

Unimproved farming technology

Unimproved farming technology is the use of old techniques, equipment and tools in agricultural production. There are several consequences that are brought about by the use of unimproved farming technologies.

1. The use of unimproved farming technology leads to a lot of time being spent to accomplish various farming tasks. This may lead to shortage in food supply since the process of agricultural production takes a very long time and the yields are low.
2. Some traditional farming practices such as shifting cultivation and open-range grazing lead to the destruction of vegetative cover, desertification and soil erosion.
3. Monocropping and monoculture lead to the spread of diseases and pests in crops due to their build-up in the soil.

Failure to adopt improved crop varieties, livestock breeds and new technology are indicators of unimproved farming technology. For agriculture to be able to meet its role of providing food security in the society, farmers must adopt new farming techniques and methods.

Improved farming technology and food supply

The indicators of improved farming include:

1. New discoveries and advances in the quality of machinery, tools and new technology equipment to improve the performance level and efficiency of the farm. The correct use of these technologies leads to an increase in crop and livestock production which causes an increase in food supply.
2. Advances in dairy farming which include animal breeding or rearing practices such as artificial insemination, machine milking, pasteurisation, packaging and storage are among the marks of technology in farming. They lead to an increase in livestock production hence ensuring a constant supply of animal products and by-products used as food.
3. There is a sustainable supply of food which is created through the use of improved technology when practising horticulture. This is possible through the production of fruits and vegetables in controlled environments such as greenhouses.

Fig. 7.1 Tomato production in a greenhouse

4. Irrigation systems have been used to provide water to crops in arid and semi-arid areas. This has led to the reclamation of land for agricultural use. More crops are then grown under irrigation increasing food supply for the rapidly growing population.

Fig. 7.2 Practising irrigation increases food supply

Activity 7.2 Researching on how improved technology increases food supply for the growing population

(a) Find out how improved technology has increased food supply in Malawi for the growing population.
(b) Discuss your findings in class.
(c) Write brief notes during the discussion in class.

Improved farming technology and food security

Food security is the sustained food supply and distribution to the target population throughout the year. There is need to match the rapidly increasing food demand in ways that are environmentally and socially sustainable. This requires the use of improved technology in the ways food is produced, stored, processed, distributed and accessed.
The strategic farming technologies which lead to food security include:

1. *Mixed farming technologies* — They help to address the adverse climate changes that lead to global warming thus reducing the quantity of yields produced. Farmers should keep livestock and also grow crops so that there is a constant supply of agricultural products from the two farming activities.
2. *Adoption of agricultural knowledge from research findings* — Adoption of new technologies will help improve crop and animal yields. These include the use of biotech seeds, irrigation and crop rotation which lead to improvement in yields. Biotech seeds are used in producing genetically modified foods. This will ensure that everybody in the country will have food at all times thus leading to food security.
3. *Growing drought tolerant crop varieties* — This will lead to production of food crops throughout the year. Livestock with good characteristics should be cross-bred to produce livestock which grow fast and produce maximum yields.

4. *Conservation tillage* — This will prevent soil degradation through soil erosion. It will also ensure that organic matter content is high in the soil thus increasing its fertility. This will in turn increase crop yields ensuring there is food security.

Fig. 7.3: Genetically modified foods

5. *Farmers should practice crop rotation* — This will help to break the cycle of pests and diseases. It will also ensure that the soil nutrients are maintained. Growing of leguminous crops in the rotation will ensure that nitrogen is fixed into the soil thus maintaining the soil fertility. This will lead to an increase in food production thus ensuring food security.

6. *Use of improved farming technologies for storage* — These include appropriate storage facilities for crops and grains to ensure that the food produced can be stored appropriately for a long time. This will in turn ensure that food is made available to everyone even during the dry season.

Fig. 7.4 Steel grain silos are used for storing grains for long periods

7. *Use of improved farming technologies for processing* — Improved farming methods have led to an increase in agricultural production. This has led to the development of agricultural processing industries that process the food into products that can be used over a long period of time since they have been well preserved. This guarantees food security since the food is not wasted. Perishable foods can be processed and stored for long periods.

Fig. 7.5 A fruit processing industry

Activity 7.3 Discussing how improved farming technology affects food security

(a) Your teacher will invite a resource person from the Ministry of Agriculture in Malawi to give you a talk on food security.

(b) Find out from the resource person how improved farming technology affects food security.

(c) Write a brief report after the discussion on the influence of improved farming technology in ensuring food security.

Practical activities

1. Under the guidance of your teacher, visit a nearby modern farm and observe some of the technology being applied on the farm.
2. Find out from the farmers how the improved farming technologies they have adopted led to an increase in agricultural productivity.
3. Discuss with the farmers the contributions made by extension, research and mechanisation in ensuring food security in the country.

Summary

- Improved farming technology helps to improve agricultural productivity. This involves the use of modern farm machinery and equipment, improved crop varieties and animal breeds, integrated pest control strategies, use of fertilisers and improved farm management practices.
- Technology can be classified into two: improved and unimproved farming technology.
- Unimproved technology involves the use of old techniques and equipment in agricultural production.
- Improved farming technology includes the use of new discoveries from research, advancements in agricultural farm machinery, and improved technology.
- Strategic farming technologies that lead to improved agricultural production

Chapter 8

Agricultural marketing and trading

Introduction

Marketing refers to all the processes involved in the transformation of products from the point of production to consumption. Agricultural marketing is therefore very important in promoting agricultural development. It ensures that the farm produce or products be moved from the farm to reach the consumer when required.

Success criteria

By the end of the chapter, you must be able to:

(a) distinguish between marketing and trading

(b) list marketing channels and agencies

(c) explain the roles of channels in marketing agricultural commodities

(d) distinguish marketing costs and marketing margins

(e) describe effects of population distribution on marketing

(f) explain the importance of trading of agricultural commodities

(g) outline ways of improving trading of agricultural commodities.

Definitions

Marketing

Marketing has many definitions. Marketing can be defined as the process of providing the right products at the right time and place. In Form 1, we defined marketing as activities that direct the flow of goods and services from the producers to the consumers.

For most commodities, the marketing process has certain vital activities that need to be performed such as transportation, processing, grading, packaging, storing and selling. Once they have all been achieved, then the marketing process is complete.

Marketing includes the coordination of four elements called the *4 P's* of marketing, namely:

1. Identification, selection and development of a *product*.
2. Determination of its *price*.
3. Selection and distribution of the product to reach the customer *place*.
4. Development of a *promotional* strategy.

Trading

Trading refers to the process of buying and selling of goods and services or exchange of commodities. Unlike marketing, trading is concerned more with exchange of cash for agricultural products. It is done after the process of marketing has been completed effectively.

Activity 8.1 Discussing the differences between marketing and trading

In class, discuss the differences between marketing and trading. Write the differences you have discussed in your notebooks.

Marketing channels and agencies

Marketing channels

Marketing channels refer to the means or ways through which agricultural products are made available to the consumers. All agricultural products go through the marketing channels to ensure that they are availed to the consumer. This is because the sale of the products is not always direct. It can be through intermediaries such as the wholesaler/ distributor, retailer or agents. For instance, the manufacturer or producer of agricultural products does not necessarily have to sell them directly to the consumer. There are various marketing channels that can be used. They include:

- Manufacturer to consumer.
- Manufacturer to retailer to consumer.
- Manufacturer to wholesaler to retailer to consumer.
- Manufacturer to agent to wholesaler to retailer to consumer.

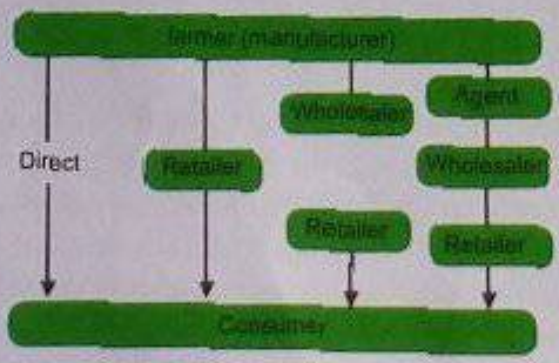

Fig. 8.1 Marketing channels

Activity 8.2 Discussing the meaning of terms

In pairs, discuss the meaning of the following terms:

- marketing
- trading
- marketing channels
- marketing agencies.

Manufacturer to consumer

In this case, the agricultural products are sold directly to the consumer without any intermediaries such as the wholesaler or retailer. For example, small scale farmers usually sell their produce directly to the consumers without using cooperatives or wholesalers.

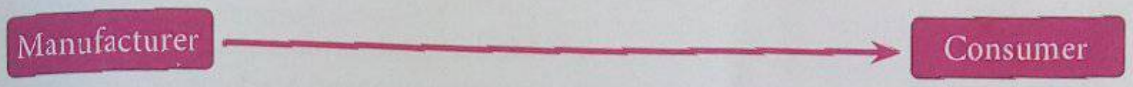

Fig. 8.2 Channel of distribution 1

Manufacturer to retailer to consumer

This involves the sale of agricultural goods or products from the farmer to a retailer. The retailer then avails the products to the consumer. This type of channel is mostly used in the sale of processed agricultural products. It can also be used in selling agricultural products such as maize that has been produced on a large scale.

Fig. 8.3 Channel of distribution 2

Manufacturer to wholesaler to retailer to consumer

The farmer sells his or her agricultural products to a wholesaler who in turn sells them to a retailer. The retailer eventually sells the products to the consumer.

Fig. 8.4 Channel of distribution 3

Manufacturer to agent to wholesaler to retailer to consumer

In this is a type of marketing a middleman (agent) is brought in to help with the distribution of goods to the other intermediaries. The agent is usually given a commission by the farmer (manufacturer). Farmers may opt to use agents when they want their products to reach the consumer faster. The agents distribute the goods to the wholesalers who then sell them to the retailers and finally the retailers sell to the consumers.

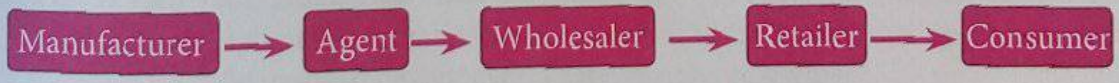

Fig. 8.5 Channel of distribution 4

Marketing agencies

Marketing agencies are referred to as bodies or organisations which are involved in one or more marketing functions. As we learnt in Form 1, marketing functions refer to all the activities or roles that help an individual, group or company to identify and source potentially successful products for the market place and then promote them by differentiating them from similar products.

Marketing agencies differ from one country to the other. The common feature is that in each country, there are many marketing boards formed to market different agricultural

products under the Ministry of Agriculture. Some common examples of marketing agencies in Malawi include:

- Itinerant traders
- Processors
- Wholesalers
- Retailers
- Brokers and agents
- Cooperative societies and unions such as Mpoto Dairy Farming Association (MDFA)
- Marketing boards such as Agricultural Development and Marketing Corporation (ADMARC).

Itinerant traders

These are middlemen who move from place to place buying agricultural produce of various types from farmers. They can buy cattle, sheep, goats, grains or vegetables.

They sell to large businesses in big towns. The products are then sold to consumers. They therefore perform the functions of buying, assembling and transportation.

Processors

Some marketing boards undertake processing of raw products into finished commodities. Such processors transform raw products into more usable forms such as processing maize flour, juices, tea, coffee, baking flour, sugar and butter.

Fig. 8.6 Traders buying cotton from farmers

Wholesalers

Wholesalers buy in bulk from processors or manufacturers and sell to smaller traders who later retail in small quantities. They repackage goods into smaller units that are desirable to the consumer.

Retailers

Retailers buy in bulk from wholesalers and sell to customers in small bits. Some companies or organisations are involved in both wholesale and retail trade. They may repackage or break down goods into smaller quantities. They display goods to the consumers.

Brokers and agents

Brokers and agents are middlemen who act on behalf of others and are paid a commission fee. They link up buyers to sellers and sellers to buyers who then transport business and pay them commission.

Cooperative societies and unions

Cooperative societies are common marketing agencies in many parts of the world and within the country. Farmers form societies or unions at local or district levels which then get affiliated to national cooperative society. This arrangement makes marketing of agricultural produce or other products easy, starting from villages to national or international markets.

Marketing boards

The Government encourages the Ministry of Agriculture to form marketing boards for important crops to make the sales to be done easily. In Malawi, crops like coffee, sugar, tea, rice and tobacco are marketed through various boards. Marketing boards provide means by which the governments participate in marketing. Where boards are efficient, they can enhance marketing efficiency to benefit both the producers and consumers.

The board attempts to stabilise the producer (farmer) incomes by means of orderly market control. They help to increase producer incomes by overall production restriction programmes. For example, they attempt to control production by giving producer production quotas.

Activity 8.3 Listing marketing channels and agencies

(a) In groups of five, identify the marketing channels that are used by farmers in your local area.

(b) List the examples of marketing agencies used by farmers in your local area to market their agricultural produce.

Roles of marketing channels and agencies

1. They provide information on the needs and demands of the consumers to the manufacturers.
2. They ensure that the market prices of goods are kept stable so that they do not keep on fluctuating.
3. Marketing channels and agencies promote and advertise agricultural goods or products in specific areas. They come up with the sales incentives that are used to attract customers.
4. They link the producers to the consumers.
5. They distribute and make agricultural goods available to consumers.
6. They provide market for the farmers produce.
7. They provide the farmer with information and some of them such as cooperative societies provide input to farmers at farmer subsidised prices.

Activity 8.4 Researching on the roles of channels and agencies in marketing

(a) With the help of your teacher, identify a marketing agency or one of the marketing channels around your school.

(b) Find out from the resource persons the roles of channels and agencies in the marketing of agricultural commodities.

(c) Write a report on the roles of channels and agencies in the marketing of agricultural commodities.

Marketing costs and margins

Marketing costs

Marketing costs refer to the total cost associated with delivering agricultural commodities from the farmer to the consumer.

The marketing costs may include expenses associated with transferring goods to the customer, storing goods in warehouses while pending delivery, promoting the goods being sold, or costs associated with distribution of the product to the point of sale.

Marketing cost = Total cost associated with delivering the product to a consumer.

Example:
Umika sold 300 bags of mangoes. He used MK 1000 to transport the mangoes to the market. Initially, he had spent MK 400 per day in storing the mangoes in a warehouse pending delivery for 2 days. Calculate his marketing cost.

Marketing cost = Total cost associated with delivering to the consumer
= 1000 + 400 + 400
= MK 1,800

Marketing margins

Marketing margins refer to the difference between the cost of purchasing items and the income made from selling them. Marketing margins are calculated in nearly every business to find out the profits being made. A high marketing margin shows that the level of profitability is high whereas low marketing margins show that the level of profitability is low. Marketing margins directly affect the amount of marketing that will be done for agricultural products.

Marketing margin = Cost of selling item – cost of purchasing items (raw materials)

Example:
A farmer bought a litre of milk at MK 40. He made cheese from the product and sold it at MK 100. Calculate the marketing margin of the farmer.

Marketing margin = Cost of selling item – cost of purchasing item (raw material)
= 100 – 40
= 60
Marketing margin = MK 60

Relationship between marketing costs and margins

The function of a marketing margin is to assist in the calculation of how much funding can be used to bring a given product to the market. The gap between what you pay to purchase the goods and what you charge the customers to buy it is determined by the financial resources available. For example, if your margins are too small to cover the cost of advertising, storing, and selling the goods, then either the retail price will be high or the marketing budget will have to be cut significantly.

The marketing margin directly affects the types and amount of marketing that your small business can produce and distribute.

Activity 8.5 Calculating marketing costs and marketing margins

(a) Visit a cooperative society around your school under the guidance of your teacher.
(b) Collect data on the prices of different agricultural commodities from farms and the prices at which they are sold to the consumers.
(c) Record the data in your notebooks.
(d) Calculate marketing costs and marketing margins using the data that you have collected. Use a table such as the one shown below.

Commodity	Purchasing price	Marketing cost	Selling price	Marketing margins

Effects of population distribution on marketing

Activity 8.6 Discussing the effects of population distribution on marketing

In groups of five, discuss the effects of population distribution on marketing. Present your findings in class.

In order to plan for the marketing process, buyers or consumers are needed and thus are very important in the marketing process. The more the buyers, the more one would sell assuming that more people have money to buy the commodity.

1. High population in an area creates a better market for agricultural produce because most of the agricultural produce is actually food. Where population distribution is low, the demand will also be low thereby affecting marketing of agricultural produce. Marketers will also move commodities from areas of low population to areas where the population is high.
2. A high population will make the marketing channels to be longer. This means that there will be more middlemen in the marketing process which sometimes makes prices of commodites to go up. However, in areas where there is low population, the marketing channels are shorter.
3. More advanced means of transport are being used in areas where the population is high to ensure that commodities reach the consumer at the appropriate time.
4. The products sold in areas of high population are of good quality due to the competition among traders who want to ensure that their products are bought in large quantities by consumers.

5. More advanced methods of advertising are being used in highly populated areas to target different groups of consumers.

Importance of trading in agricultural commodities

Trading of agricultural commodities is very important not only to a country but to the whole world. Agriculture provides food which is most essential for human survival. Trading of agricultural products ensures that the food is made available to the population of a certain area.

1. Importance of trading at community level

(a) At community level, trading of agricultural commodities enables those who do not get adequate food from their farms to buy from those who have a surplus. This is done through community markets. By doing this, the food in a region is redistributed without having to travel very far.

(b) Within the community there are traders of agricultural commodities who buy and sell, hence they get self employed. They earn income from their trading activities.

Fig. 8.7 Selling of agricultural produce at the community market

(c) Trading is a source of revenue for the local authorities who charge the traders a small fee so that they can allowed to sell their produce in the market.

(d) Within the community are business people who buy agricultural produce in large quantities, during harvest, time. They store the products and sell to the same members of the community when there is shortage of food. This kind of trade provides food security within the community.

(e) Buying and selling ensures there is a flow of cash in the community. If the harvest is plentiful, then people from outside the community come to buy bringing more cash into the community.

2. Importance of trading at national level

(a) Trading provides employment to those in the trading system.

(b) It provides markets for the farmer produce from various parts of the country. This is because national marketing boards are able to buy most produce from farmers directly during harvest. This is a good incentive for farmers since they are assured their produce will have a ready market.

(c) Primary cooperative societies can also sell their produce to national cooperative societies. This provides a good market link from the local community to national level.

(d) Trading in agricultural commodities is vital for food security in a country. National marketing boards buy grains during harvest time and keep time in national stores. When there is food shortage, they will sell the food at reasonable prices, compared to what private traders would charge.

(e) Marketing boards trading at national level in agricultural commodities provide storage facilities for food. This food will later be redistributed to the whole country through various marketing channels.

Fig. 8.8 Grains stored in a godown for use when there is food shortage

3. Importance of trading at international level

Activity 8.7 Discussing the importance of trading of agricultural commodities

(a) Carry out research in the school library or on the Internet to find out the importance trading in agricultural commodities at:
- community level
- national level
- international level.

(b) Report your findings in class.

(a) Trading at the international level enables the country to earn much needed foreign exchange. Malawi is basically an agricultural country and thus needs imports such as machinery and oil. These can only be acquired using the foreign exchange earned. The more the agricultural commodities the country exports, the more the foreign exchange earned.

(b) Importation of food to meet our food deficit is only possible through international trade. Other products can be imported as well.

(c) A good relationship is established between our country and the countries we trade with. By so doing, our country can get international aid for development and peace is established with our neighbours.

Ways of improving trading of agricultural commodities

There are several ways of improving trade in agricultural commodities at the community, national and international level. Below are some of them.

1. Formation of producer cooperative societies right from local to national level is a sure way of improving trade. Malawi farmers fear growing new crops for lack of market, but any crop can sell so long as a cooperative society can provide links and market their produce in the local, national and international markets.

2. Value addition is a more economical way of earning more money. Instead of exporting raw products such as coffee, the country can process the coffee and export it as a finished product. By so doing, the country will earn a lot of foreign exchange hence farmers get good returns. Value addition should therefore be encouraged in all sectors of agriculture.

3. Provision of appropriate storage facilities would help improve agricultural trade. Most agricultural produce requires specialised storage facilities. Fish, milk and fruits need cold storage facilities while maize and other grains need large and dry storage facilities. These are not easy to build. If such facilities can be made available at local and national levels, then trade in agricultural commodities would improve because the quality of the commodities will improve and they can stay fresh for longer periods.

4. Good roads are necessary to transport bulky and heavy agricultural commodities like sugarcane, maize and fruits to the market without delay. Areas of high agricultural potential receive a lot of rainfall which makes dry weather roads in such areas to be impassable during wet seasons.

5. The farmers should be given subsidies on agricultural inputs such as tractors, certified seeds and fertilisers. If this is done, then many farmers in Malawi will increase their levels of production and there will be more business.

Fig. 8.9 Farmers should be given subsidies such as fertilisers

6. Making capital available to traders of agricultural commodities would improve the trade in a sense that existing traders or farmers would step up their operations. Capital can be made available by giving loans with easy terms of repayment like low interest rates, low rates of payment and less collateral or security.

Practical activities

1. From your locality, identify wholesalers, brokers and itinerant traders. Find out from them the activities they carry out in marketing and trading of agricultural commodities.

2. Find out ways of improving trading agricultural commodities in your local area.

Summary

- Agricultural marketing is the process through which agricultural products are made available from the producer to the consumer. It involves a series of activities which ensures that the goods reach the consumers.
- Trading is the process. This process of buying and selling ensures that there is a flow of agricultural goods from the farmer to the consumers.
- There are various marketing channels for agricultural products.
- Marketing agencies are bodies or organisations that carry out one or more of the marketing functions.
- Marketing boards are legal bodies that carry out the marketing of specific agricultural products.
- The various marketing channels and agencies provide information on consumer needs, ensure that market prices are stable, help in promoting and advertising agricultural goods, and act as links between the producers and the consumers.
- Market margins help in determining of the difference between the cost of buying goods and the income obtained from the goods.
- Population influences the marketing of agricultural goods. A higher population creates a market for the goods while low populations limit the marketing process.
- Trading in agricultural products can be improved through formation of producer cooperative societies, value addition, and provision of storage facilities.
- Others are provision of storage, construction of good transport infrastructure, provision of subsidies and availing of affordable capital to traders.

Revision questions 8

1. (a) Define the terms 'trading' and 'marketing'.
   (b) What are the 4 P's of marketing?
2. Name four marketing channels or agencies and explain what they do.
3. Explain the importance of trading in agricultural commodities at the national level.
4. State three ways of improving trading in agricultural commodities.
5. How does population distribution affect marketing of agricultural produce?
6. (a) Define marketing costs and marketing margins.
   (b) Explain the relationship between marketing costs and marketing margins.
7. Explain the roles of channels and agencies in the marketing of agricultural commodities.

Chapter 9

Price elasticity of demand and supply

Introduction

Price is one very important factor that determines the demand and supply of goods in a free market. There is a direct relationship between the price of the product and the quantity supplied. Simply stated, the higher the price offered on the market, the higher the supply and the lower the price, the lesser the goods supplied. The quantity demanded refers to a specific amount of a product that will be bought at a specific price over a specific period of time. Elasticity or sensitivity to price changes is therefore of great significance.

Success criteria

By the end of the chapter, you must be able to:

(a) describe price elasticity of demand and price elasticity of supply

(b) calculate price elasticity of demand and supply of agricultural commodities

(c) explain the implications of price elasticity of demand and supply on agricultural commodities.

Price elasticity of demand

It is important to understand the effect of the market demand for agricultural commodities on the changes in price. The price of agricultural commodities is very sensitive to an increase in demand. If the demand for a certain agricultural commodity increases with its supply remaining constant, then the price of that commoditiy will also increase significantly depending on the rate of demand. The price elasticity in such a situation is said to be high. However, if the commodity price does not change irrespective of demand, we would say that its price elasticity is low.

Sometimes, sensitivity is used to refer to elasticity. Price elasticity of demand of a product therefore refers to how much the quantity demanded of the product leads to a change in its price.

Put in a different way, elasticity of demand refers to the degree of responsiveness of quantity demanded of product to a percentage change in its prices.

Calculating price elasticity of demand

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Example

Banda sells a bag of maize at MK 4,000. He normally sells 700 bags every month. In the month of January, he decided to charge more money per bag. He raised the price to MK 5,000 per bag. However, he only managed to sell 400 bags. What is the price elasticity of demand?

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$\text{Percentage change in quantity demanded} = \frac{(700 - 400) \times 100}{700}$$

$$= \frac{300 \times 100}{700}$$

$$= 42.86\%$$

The quantity demanded reduced by 42.86%

$$\text{Percentage change in price} = \frac{(5000 - 4000) \times 100}{4000}$$

$$= \frac{1000 \times 100}{4000}$$

$$= 12.5\%$$

Thus the price increased by 12.5%

$$\text{Therefore, price elasticity of demand} = \frac{42.86\%}{12.5\%}$$

$$= 3.429$$

A 12.5% price increase resulted in a 42.86% reduction in demand. Price elesticity of demand for the maize was 3.429. This indicates a very elastic demand as we shall see in the next section.

Activity 9.1 Calculating price elasticity of demand

In groups of five, visit your local market and collect data on the quantities of agricultural products being bought and sold at specific prices. Collect this data for two weeks and carry out the following activities:

(a) Remind yourselves the meaning of the term 'price elasticity of demand'.

(b) Calculate the price elasticity of demand of the various products using the data that you collected.

Degrees of price elasticity of demand

Elastic demand

Demand is said to be price elastic when a change in price leads to a significant change in demand. For instance, when there is a cut or reduction in the price of a product, the quantity demanded increases. Alternatively, when there is an increase in the price of a product, the quantity demanded reduces. In this cases price elastic is greater than 1.

For example, when the price of milk goes up, there will be a great reduction in demand as some people will opt not to use milk. The implication of elastic demand is that products have to be sold at competitive prices for one to gain an edge.

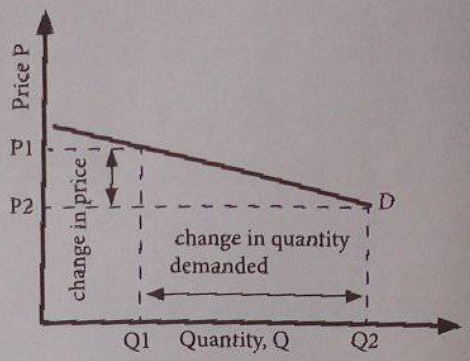

Fig. 9.1 Graph showing elastic demand

Unitary demand

In this case, a percentage change in the price of a commodity will result in an equal percentage change in the quantity demanded but in the opposite direction. For example, if the price of a commodity increases by 10%, the demand for the commodity reduces by 10%. Price elasticity of demand is equal to 1. This is common for products where buyers can get a similar alternative (substitute). For instance, if the price of cabbages goes up, buyers can opt to buy kales. The implication of unitary demand is that buyers can always get alternative products if the prices of an inferior product rises. This usually leads to great competition.

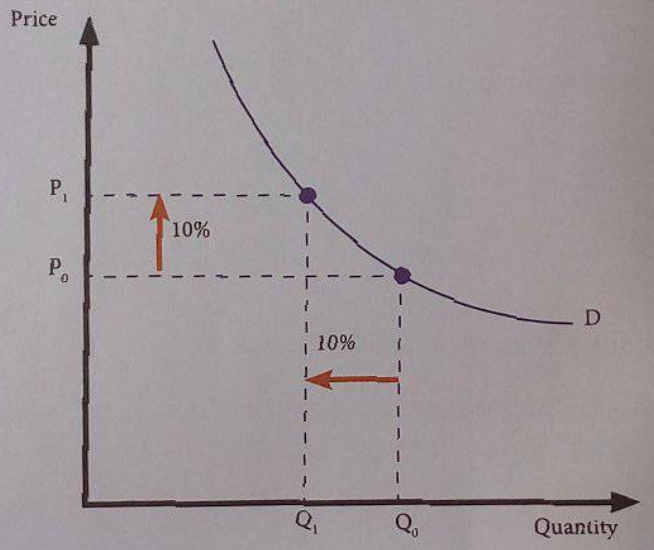

Fig. 9.2 Graph showing unitary demand

Inelastic demand

Demand is said to be inelastic when the quantity demanded of a product is not or is only slightly affected by the changes in price. Whether the prices go up or down, the buying habits of the consumers are not changed. This is mainly experienced with agricultural commodities that are very essential and which people cannot do without. If the demand is inelastic, the implication is that the price of the commodity may be raised. The profits when selling such commodities is high.

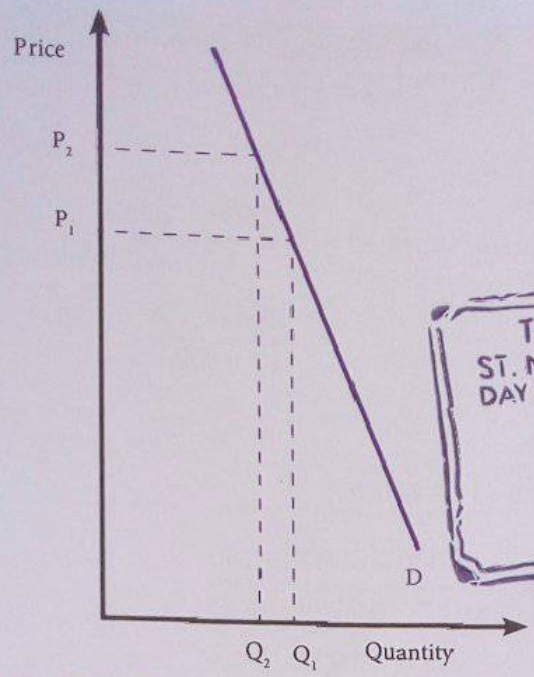

Fig. 9.3 Graph showing inelastic demand

Activity 9.2 Plotting graphs showing different degrees of price elasticity of demand

In groups of five and using the data that you had collected in Activity 9.1, plot elastic, unitary and inelastic demand graphs to show the different degrees of price elasticity of demand.

Price elasticity of supply

Price elasticity of supply is the degree of responsiveness of quantity supplied of a given product due to a change in the price of the product. It is determined by dividing the percentage change in the quantity supplied by the percentage change in price.

Calculating price elasticity of supply

$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

Example

Calculate the price elasticity of supply of beans when 1000 bags of beans were supplied in a market by Mary at a price of MK 3,000 per bag. She later on supplied 2,500 more bags to the same market when the price changed to MK 4,000 per bag.

$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$\text{Percentage change in quantity supplied} = \frac{(2500 - 1000) \times 100}{1000}$$

$$= \frac{1500 \times 100}{1000}$$

$$= 150\%$$

The quantity supplied increased by 150%

$$\text{Percentage change in price} = \frac{(4000 - 3000) \times 100}{3000}$$

$$= \frac{1000 \times 100}{3000}$$

$$= 66.67\%$$

Thus the price increased by 66.67%.

$$\text{Therefore, price elasticity of supply} = \frac{150}{66.67}$$

$$= 2.25$$

This means that a 66.67% increase in price led to a 150% increase in the supply of the beans.

Activity 9.3 Calculating price elasticity of supply

In groups of five, collect data on the quantities of agricultural commodities being supplied at specific prices in a market around your school. Collect this data for two weeks and carry out the following activities.

(a) Remind yourselves the meaning of the term 'price elasticity of supply'.

(b) Calculate the price elasticity of the commodites being supplied in your local market using the data you have collected.

Degrees of price elasticity of supply

Elastic supply

Elastic supply is when a change in price results in a great change in the quantity of commodities being supplied. The elasticity of supply is greater than 1. For example, after harvesting grains, some farmers store them for some time and wait for the prices to go up. This is when they supply the grains to the market place. Figure 9.4 shows the elastic supply graph.

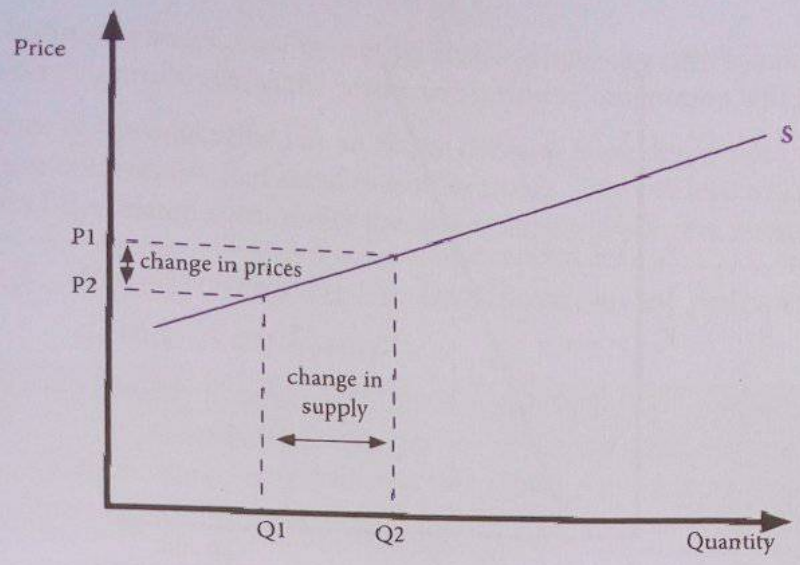

Fig. 9.4 Graph of elastic supply

Unitary supply

In this case, a change in price causes an equal or proportional change in the quantity supplied of a commodity. Price elasticity of supply is equal to 1.

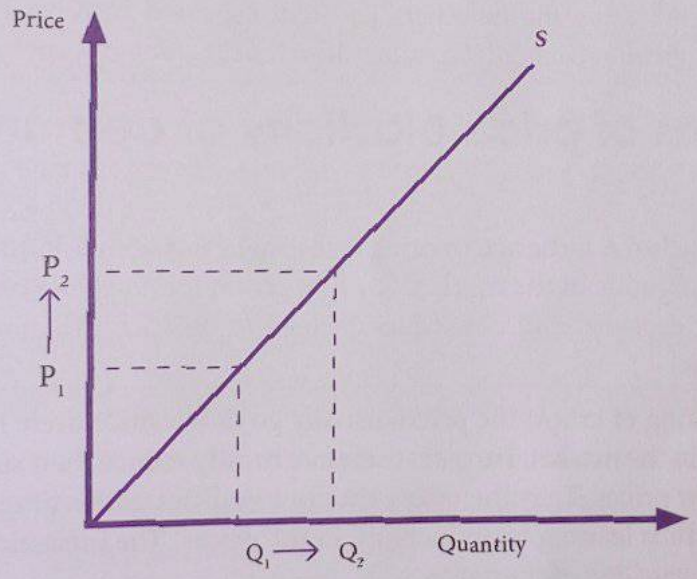

Fig. 9.5 Graph of unitary supply

Inelastic supply

Inelastic supply is when a change in the price of a commodity results in no change or a very small change in the quantity supplied. This is common where certain goods can no longer be produced. An increase in price or demand will not lead to an increase in supply since the goods are no longer being manufactured or produced.

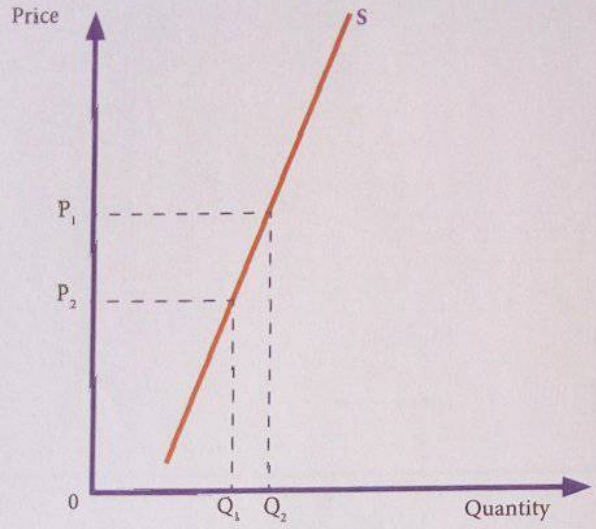

Fig. 9.7 Graph of inelastic supply

Activity 9.4 Plotting graphs showing different degrees of price elasticity of supply

In groups of five and using the data that you had collected in Activity 9.1, plot supply graphs for different products and determine the price elasticity of supply for each product.

Implications of price elasticity of demand and supply

1. As discussed above, a change in price is the main factor that influences the demand and supply of goods in the market. A slight reduction in prices of commodities will increase the demand and consequently lead to an increase in supply for unitary commodities.
2. After harvesting of crops, the prices usually go down since there is an abundance of the produce in the market. Farmers therefore mostly reduce their supply to the market due to the low prices. They then store the commodities until a time when the demand will be high thus leading to an increase in the prices. The inelastic commodities will be bought regardless of the price.
3. If producers anticipate an increase in price, they withhold the produce resulting in reduced supply. This is particularly evident when there is drought in some parts of the country and the yields are expected to be poor. Even the farmers who get good yields will not sell their produce immediately they harvest. This happens for elastic commodities so that farmers do not sell them at a low price and incur losses.
4. Government subsidies on farm inputs directly influence the prices of agricultural produce. For instance, waiving or reducing tax on fertiliser or agricultural equipment leads to a decrease in the cost of production. Thus, the cost of selling the produce will

be low leading to an increase in supply. This will have negative implications on elastic and unitary commodities as the prices will be low. Competition will also be high.

5. If the price of a product that has an elastic demand increases, people will change to an alternative commodity that satisfies similar needs. This will lead to an increase in the demand of the related commodity therefore causing producers to increase its supply.

Activity 9.5 Researching on the implications of price elasticity of demand and supply

(a) Carry out research in your school library or on the Internet on the implications price elasticity of demand and supply has on agricultural commodities.
(b) Discuss your findings in groups and take down notes during the discussion.
(c) Present your findings in class.

Practical activities

Visit your nearest market twice within a period of three months. The first visit should be on a major market day at the beginning of the month and the second visit should also be on a major market day at the end of the month. During your visits, identify one or two agricultural products you wish to study and find out the following information during each visit:

1. Which crop or crops have you identified?
2. What is the price of each crop during your first visit and last visit?
3. Find out from the sellers of that product the quantity they brought and how much they sold within the month.
4. How much change in quantity demanded of the same crop did you notice as a result of change in price?
5. Calculate the elasticity of demand for that crop during your second visit.
6. What factors may have affected the demand and supply of the crops you were studying?

Summary

- Price elasticity is the responsiveness to changes in prices of the products being demanded or supplied to changes in prices.
- The changes in price often affect the amount of goods consumers are willing to purchase at a particular price at a particular time. It also affects the amount of goods suppliers are willing to supply at a given time.
- Price elasticity of demand of a product refers to the responsiveness of demand due to a change in prices. It is calculated as the percentage change in the quantity of goods demanded over the percentage change in the price of the commodity.
- Price elasticity of supply is the degree of responsiveness of supply to a change in the price of the product. Like the elasticity of demand, it is calculated as the percentage change in the goods supplied over the percentage change in the price of the goods.

Chapter 10

Crop improvement and processing

Introduction

One of the key reasons for crop improvement is to ensure sustainable food supply. Crops can be improved through use of certified seeds that have been tested. Crop processing also aims at ensuring sustainable food supply in the country. Whereas crop improvement aims at increased yields, processing ensures the crop produced can reach the consumer in a more appropriate manner.

Success criteria

By the end of the chapter, you must be able to:

(a) describe the meaning of crop improvement

(b) describe the aims of crop improvement

(c) list activities in crop improvement

(d) describe methods of crop improvement

(e) state the importance of crop processing

(f) describe the processing of various crops

(g) describe how to process a selected crop.

Definition

Crop improvement refers to the genetic alteration or modification of plants to produce higher crop yields in order to satisfy the needs of humanity. High quality seeds and propagating materials from good quality plants can be used to produce improved crop varieties that mature quickly and are disease resistant ensuring food supply in the world. Through crop improvement, farmers are able to attain high returns from crop production thus helping in reducing poverty, especially in the rural areas.

Fig. 10.1 Bananas from improved crop varieties

Aims of crop improvement

Crop improvement is very important to the rapidly growing population. The following are the aims of crop improvement.

1. Crop improvement aims at increasing the yields of crops. High yielding crop varieties are usually used when coming up with improved crops. When grown, the crops produce high yields thus increasing food supply. Therefore, the productivity of a piece of land can easily be determined by a farmer depending on the number of seeds used during planting.
2. It aims at growing quality crops that are much healthier. The healthy crops produced have a high nutritional value. Therefore, the crops are able to provide us with the nutrients required for growth thus reducing malnutrition in the country.
3. Crop improvement ensures that the crops that are produced are pest and disease tolerant. The crops can also survive harsh weather conditions which are brought about by climate change. Thus, crops can be grown even during drought under irrigation.
4. Production of crops with good qualities for storage. The crops produced from vegetative planting materials of high quality can be stored for long periods under appropriate conditions without going bad. This ensures a constant food supply thus food security in the country and in the world.
5. Crop improvement helps in preserving the qualities of superior crops to ensure continuous production of crops that are of high quality.

Activity 10.1 Discussing the aims of crop improvement

(a) Carry out research in the school library or on the Internet to find out what crop improvement means and its aims.
(b) Discuss your research findings with your group members.
(c) Look at pictures of improved varieties of crops from magazines or from the Internet. Discuss them with your group members.
(d) Discuss your findings in class.

Activities in crop improvement

There are various activities involved in crop improvement. Every organisation involved in crop improvement performs different activities when improving the crops. Most of the activities performed involve breeding. Breeding is the process of changing specific plant traits in order to obtain desirable and superior characteristics in crops.

Activity 10.2 Listing activities in crop improvement

(a) Your teacher will organise for you a visit to an organisation that is involved in crop improvement. While at the organisation, observe the activities being performed to come up with improved crop varieties.
(b) Record these your observations in your note books.
(c) Discuss your findings in class.

Methods of crop improvement

There are three main methods that are used to improve crop varieties. These are:

- Introduction
- Selection
- Hybridization.

Introduction

Introduction refers to a process where a certain crop variety is brought to a new area. This means that the crop is grown under different climatic conditions from those it was well adapted to. For example, tobacco was introduced in Malawi and now it is one of the main crops for export.

Selection

This involves the identification of plants or crops with desirable qualities and then breeding is done. Breeding is done through self and cross pollination. There are two methods of selection:

- mass selection
- pure-line selection.

Mass selection

Seeds of various crops with desirable qualities are selected. The seeds from the selected crops are mixed and planted to come up with the next generation of crops. This method has been used in improving the varieties of seeds leading to imported crop varieties.

Selection of naturally occurring plant varieties is the basis of crop improvement. This is the simplest and least expensive method of crop improvement.

Alternatively, the best crops can be chosen and harvested separately. Their progeny can then be grown. Their seeds are harvested and preserved for future crops.

Pure-line selection

This is also referred to as single plant selection. Crops that appear to have desirable qualities from a healthy population are selected. Progenies from the selected crops are then planted and observed frequently over a period of years. The best progenies that have the most superior qualities are then chosen as pure-line breeds. Seeds from pure-line breeds are usually similar in appearance and performance.

Fig. 10.2 Tomatoes grown from a pure line breed

Hybridization/breeding

Activity 10.3 Researching on the methods of crop improvement

(a) Your teacher will organise for a class visit to an agricultural research institute.
(b) While there, find out which crop improvement methods they have adapted.
(c) Write brief notes from the discussion and your own observations.
(d) Discuss your observations in class.

This is the combination of genes found in two or more crops to come up with pure breed progenies that are superior to the parent crop in all ways. Improvement through selection is incomplete unless the selected plants are multiplied through hybridization in the breeding process.

Plant breeding is the science of changing specific plant traits to come up with plants that have the desired characteristics. This process is normally carried out by professionals through research. The seeds from the hybrid varieties are then given to farmers.

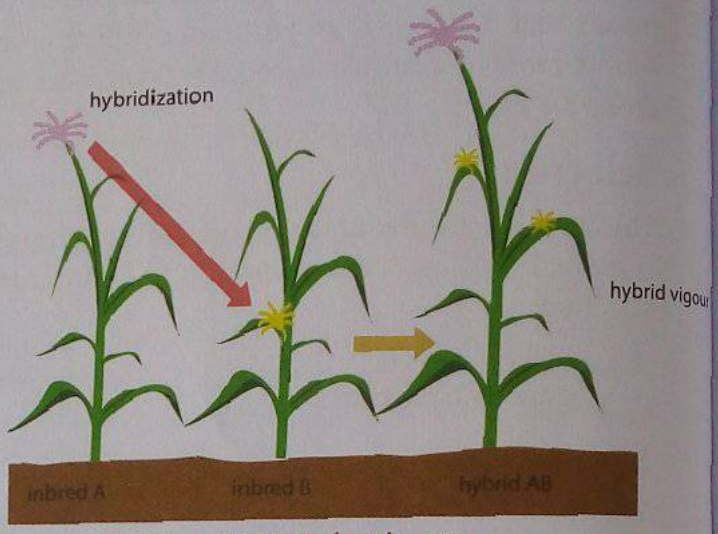

Fig. 10.3 Hybridization

In Figure 10.3 above, inbred A was crossed with inbred B as shown by the arrow. The new crop produced was hybrid AB which had the traits of inbred A and inbred B. Hybrid AB is therefore superior than A or B.

The desired traits that breeders have tended to develop in various crops include the following:

1. Increased quality and yields of crops.
2. Increased tolerance to environmental pressure—soil salinity, extremes of temperature and drought.
3. Resistance to viruses, fungi and bacteria.
4. Increased tolerance to insect pests.
5. Increased tolerance to herbicides.
6. Adaptation to resist such mechanisation as shattering when being harvested using machines.

Crop processing

Crop processing is the conversion of raw agricultural produce into products that are more valuable, usable and marketable. Crop harvesting involves all the post harvesting activities that are carried our by farmers and cooperative societies.

Importance of crop processing

Activity 10.4 Discussing the importance of crop processing

(a) Visit your local shops and identify foods that have been processed from crops grown in Malawi. List them down in your note books.

(b) In your groups of five, discuss why processing of foods you have identified in (a) above is important.

(c) Share your findings in class.

Below are various reasons why it is important to process crops.

1. Crop processing *improves the shelf-life of the agricultural products.* This is because during food processing, preservatives are added to the processed food crops to ensure they last long.

2. During crop processing, various additives and flavours are used and this helps in *improving the taste of the finished food products.*

3. *Processing adds value to the crops.* For instance, when wheat is processed into wheat flour, the wheat can be used for different purposes.

4. Most crops are usually bulky before they are processed thereby making the process of transportation difficult. After crop processing, the products are less bulky and thereby easier to transport.

5. In order for crops to be processed, there is need to have industries. These industries *provide employment to people living in that particular area*, thus reducing the number of unemployed individuals.

6. *Crop processing improves the quality of the finished products.* The final product therefore fetches more money compared to the raw crop. For example, once the coffee beans are processed and sold as refined coffee, the coffee fetches more money.

7. *Crop processing ensures that there is a constant supply of food* thus leading to food security. This is because processed foods can be stored for long periods of time and thus are used when there is food shortage in the markets.

Processing of various crops

Crop processing involves changing the forms of harvested crops from their raw form into consumable forms through activities such as threshing, removal of husks, cleaning and the actual processing into other products such as flour.

Processing of maize

Processing of maize starts by cleaning and removal of foreign particles from the maize grains. This is done after the maize has been harvested and shelled. The maize is then dampened using water and left for some time. This process is known as conditioning. The husks are then removed. After the husks have been removed from the grains, the maize is then dried to the right moisture content. The flour is then passed through a sifter to obtain

various grades of maize flour. The flour is packaged, weighed and sealed after which it is ready for distribution to the market.

When processing popcorn maize, the maize is cleaned and conditioned. The germ is then removed and the maize dried to the required moisture level before packaging.

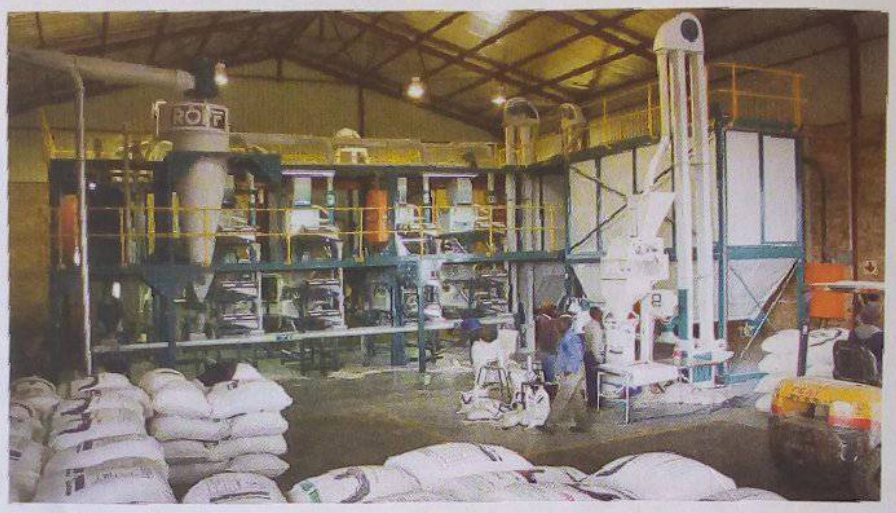

Fig. 10.4 A maize processing factory in Malawi

Processing of groundnuts

The major processing activities for groundnuts include removal of shells. This can be done using shellers in a factory. Cleaning is then done and this involves the removal of foreign particles such as soil or sand particles, twigs and grains from other crops. The seeds are then dried to the required moisture content.

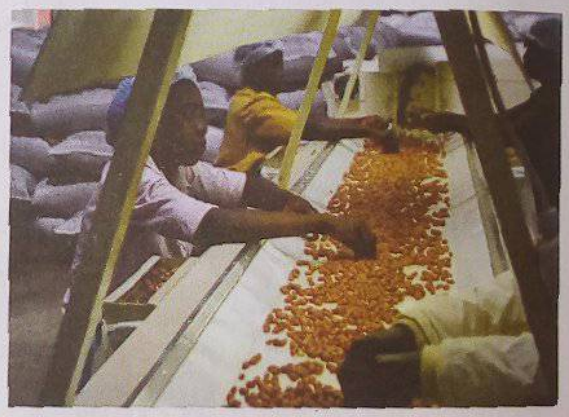

Fig. 10.5 People cleaning groundnuts in a processing industry

Some of the groundnuts are roasted and then cooled by blowing air onto them. Roasting can either be dry roasting or oil roasting. Dry roasting is where the groundnuts are roasted using heat. In oil roasting, the groundnuts are roasted in hot oil at very high temperatures. Finally, the groundnuts are packaged and then distributed to consumers. When making peanut butter, the peanuts, after being roasted, are crushed into various sizes and then processed. The by-products of groundnuts are used in making groundnut cakes which are used as livestock feed.

Processing of mushrooms

In the mushroom processing industry, fresh mushrooms are cleaned. This is done using cold water. This process is done manually because of the irregular shapes of the

mushrooms. The mushrooms are then conditioned in boiling water for around 4 minutes. The mushrooms are then treated in brine solution to prevent discolouration. Brine is a solution made from salt or sodium chloride and water.

The mushrooms are then dried. Drying can be done through hot air drying, freeze drying, vacuum drying or microwave drying. Sun drying can also be used although it is a very traditional method used by small scale farmers and takes a very long time.

Fig. 10.6 Mushrooms being cleaned

The dried mushrooms are then broken into appropriate sizes and packaged in air tight bags or tins.

Processing of mangoes

The mangoes are washed manually in water. They are washed a second time in a machine with a brusher that removes all the remaining dirt. The fruits to be sold are then coated with a thin layer of wax to slow down the deterioration process of the fruits and to make them appealing to the eyes. They are then packed in boxes and distributed.

Fig. 10.7 Mangoes being cleaned in a processing industry

In other cases, after cleaning, the ripe mangoes are machine peeled and cut into small sizes. The seeds are then removed. The sliced mangoes are then made into pulp. The pulp is used in making a wide range of products such as juices, jams, drinks and fruit cheese.

Some of the mangoes are sliced, processed, packaged and sold as canned fruits. Ingredients such as sugar, ascorbic acid and food colour can be added to the mangoes to improve their taste and make them look attractive.

Processing vegetables

Vegetables are perishable. Therefore, after harvesting, they should be cleaned to remove soil particles and any other type of dirt. In commercial vegetable processing factories, cleaning can be done using pressurised air blowers.

The vegetables are then cooled to stop the physiological activities. Artificial drying can be done by machines to remove any remaining moisture. In small scale production of vegetables, this can be done by sun drying the vegetables then packing them in airtight bags and storing them well.

In the proccessing factories the vegetables can also be canned. Additives are then added to improve the taste of the vegetables.

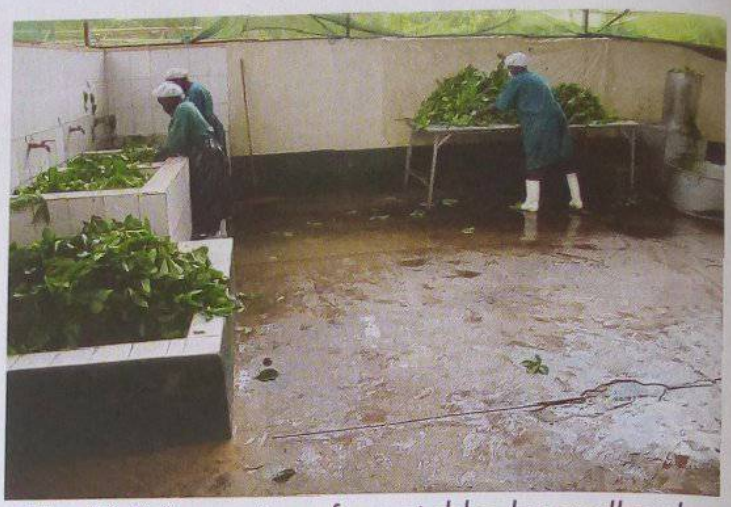

Fig. 10.8 Processing of vegetables by small scale farmers

Activity 10.5 Describing how to process a selected crop

(a) Form groups of five. Your teacher will provide each group with a sample crop. In your groups, carry out research on the processing of the crop you have been given.

(b) Discuss with your group members how the crop is processed and make short notes.

(c) Present your findings in class.

(d) Your teacher will giude you on how to process some of the crops you have been studying.

Practical activities

1. Visit the farms around your local area and observe how farmers carry out processing of different crops.
2. Write an essay on how processing of various crops is done in your local area.

Summary

- Crop improvement is the genetic alteration or modification of plants to produce plants with desirable characteristics.
- Crop improvement programs aim at producing crops with desirable characteristics like increased yields, faster growth, disease resistance and long shelf life while maintaining quality.
- In order to produce crops with desirable characteristics, crop scientists engage in breeding programmes, testing the crops for resistance to diseases, tolerance to adverse weather and adaptability.

Chapter 11

Pasture

Introduction

Pasture refers to land that is covered by grass and other low plants suitable for grazing animals, especially cattle or sheep. Good pasture should be environmentally and economically sustainable in meeting the needs of the grazing livestock.

Grass is the main food for cattle. The quantity and quality of food given to a mature animal should be enough so that it can produce maximum yields. In young animals, the food should cater for growth requirements. The quantity to be given to each animal will depend on the quality of the grass.

Success criteria

By the end of the chapter, you must be able to:

(a) state the meaning of the term 'pasture'

(b) explain the importance of pasture

(c) state the types of pasture

(d) describe methods of pasture establishment

(e) explain advantages of each method of pasture establishment

(f) explain the disadvantages of each method of pasture establishment

(g) state the meaning of the term 'seed rate'

(h) describe factors affecting pasture seed rate

(i) describe how to treat pasture seeds

(j) explain the importance of each method of pasture treatment

(k) identify proper time for pasture establishment

(l) explain activities involved in pasture management

(m) describe grazing systems in pasture management

(n) explain methods of pasture conservation

(o) conserve pasture

(p) describe factors that affect the quality of conserved pasture.

Definition

Like we have seen in the introduction, pasture refers to land that is covered by grass and other low plants suitable for grazing livestock. The livestock can be allowed to graze directly on the grass or the forage crop can be cut and fed to the cattle in a feedlot. Pasture also refers to grass or forage crops that grow naturally and which are suitable for livestock.

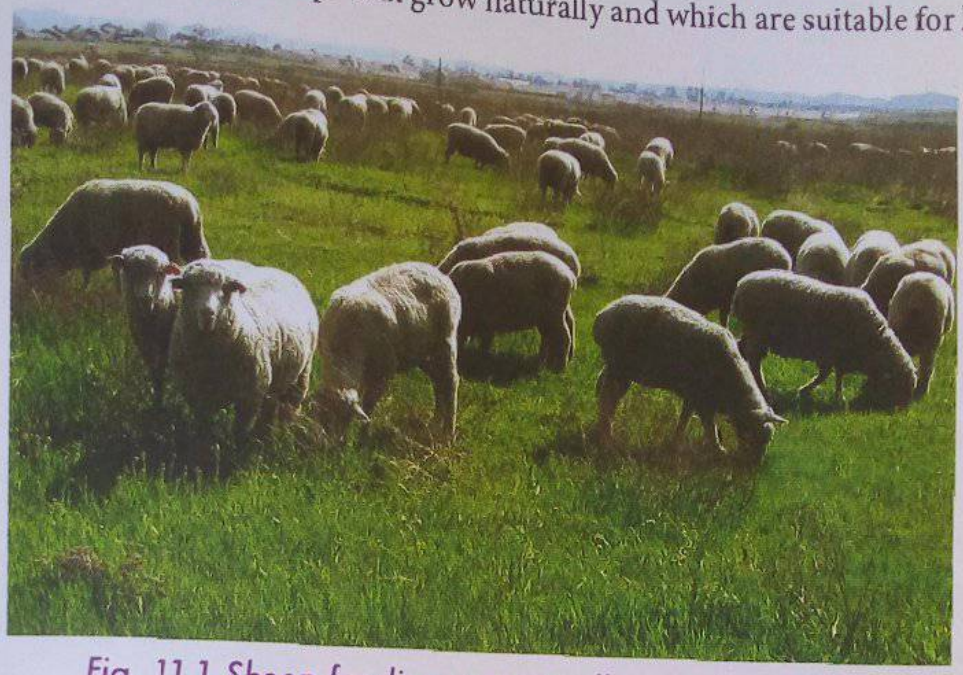

Fig. 11.1 Sheep feeding on naturally growing pasture

Importance of pasture

1. *Pasture provides livestock with food.* Animals that feed on pasture are less stressed, fertile and live longer than those fed on commercial feeds only. The livestock fed on pasture also provide human beings with good quality meat.
2. *When pasture is planted, it acts as a permanent cover crop.* The soil is therefore protected from agents of soil erosion such as water and wind. The roots of the plants hold the soil particles together thus help to control soil erosion.
3. *Pasture helps to improve soil structure.* This is because pasture ensures that the nutrients in the soil are maintained thereby improving the soil fertility. A soil that is fertile good for crop growing.
4. *Pasture adds nutrients to the soil.* Grass and other plants that are leguminous fix nitrogen into the soil thus adding nutrients into the soil in case they get depleted.
5. *Pasture can also help to reduce pests and diseases in livestock.* When rotational grazing is practiced, livestock are grazed in paddocks. This reduces the spread of diseases and pests that may be obtained from pasture. When the pasture is left to grow over a period of time, the pests and diseases are eliminated thus reducing the spread in livestock.

Activity 11.1 Discussing the importance of pasture

(a) Carry out research in your school library to find out the meaning of the term 'pasture'.

(b) Observe different pictures showing natural pasture and those that have been grown by humans. Note down the types of pasture you have seen in the pictures and some of the differences they have.

(c) In groups of five, discuss the importance of pasture.

Types of pastures

Many methods can be used to classify pasture but the most common classifications we shall use in this chapter are:

- Indigenous pastures.
- Exotic pastures.

Indigenous pastures

This refers to the naturally growing pasture. This type of pasture is common in communal grazing fields. They are usually poorly managed and have low productivity.

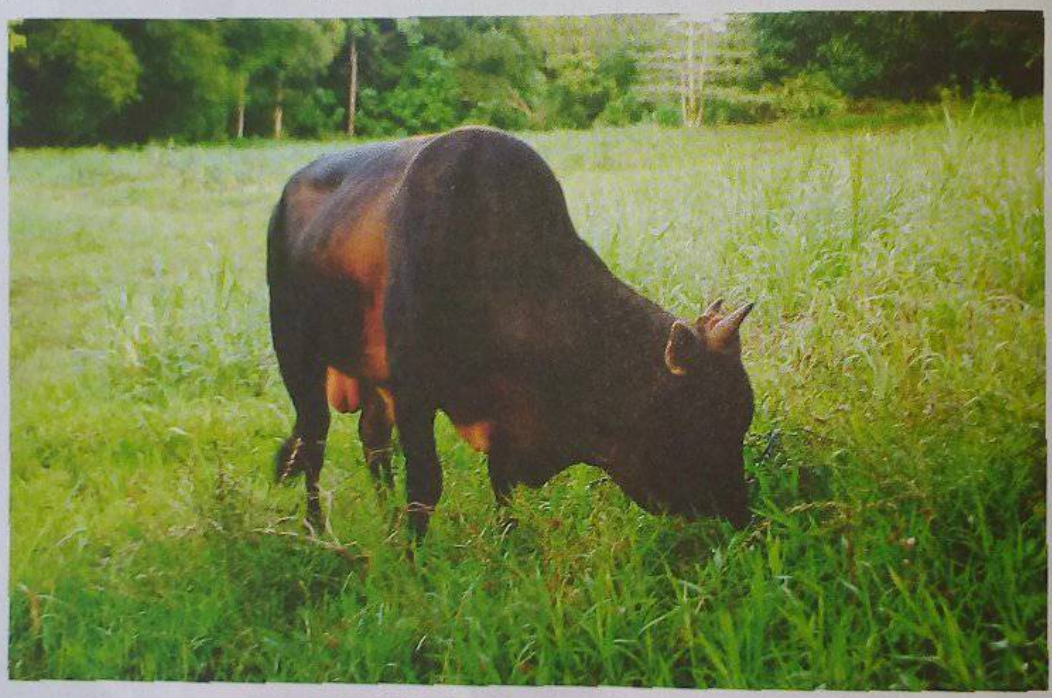

Fig. 11.2 Indigenous pasture

Exotic pastures

Exotic pastures are artificially established or grown. If only grass or only legumes are grown, then the pasture is referred to as a pure stand of grass or a pure stand of legumes. If grasses and legumes are grown together, then the pasture is referred to as mixed pasture. Mixed pastures are usually more nutritious and productive.

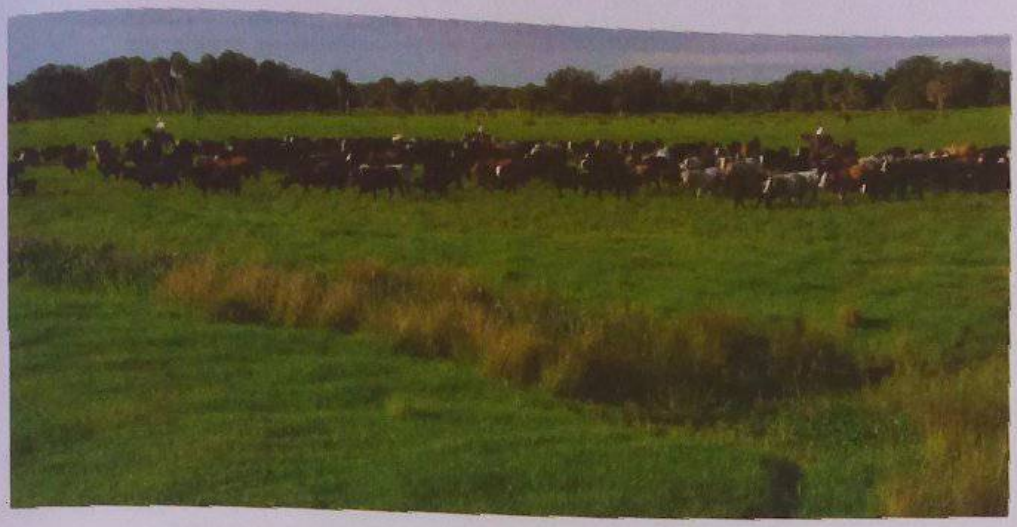

Fig. 11.3 Exotic pasture

Activity 11.2 Observing different types of pasture

(a) Your teacher will organise for you a visit to nearby livestock farms. Observe the different types of pastures on the farm.

(b) Record your findings and discuss them in class.

Methods of pasture establishment

Pasture can be established through the use of seeds (sexual propagation) or vegetative planting materials (asexual propagation). It requires efforts and capital input to establish a good pasture. Before farmers establish pasture in a certain area, they should consider the following factors.

(a) The fertility status of the soil to support pasture growth. Determining the fertility status will enable the farmer to know the amount of fertiliser or manure that needs to be added to improve soil fertility.

(b) The land should be free from water logging and it should be located near a source of water.

(c) For dairy cattle, the farmer should consider the distance from the milking parlour or shed.

The methods of pasture establishment include:

- Broadcasting
- Drilling
- Vegetative propagation
- Under sowing
- Over sowing

Broadcasting

Broadcasting is the act of scattering seeds by hand or using a seed broadcaster. When establishing pasture, the field should be divided into small plots. The seeds should also be divided and broadcasted depending on the size of each plot. The seeds should then be covered lightly with soil. Fertiliser can be added depending on the fertility level of the soil.

Fig. 11.4 A farmer using a seed broadcaster

Advantages of broadcasting

1. It is less expensive and requires minimal labour.
2. It takes a very short time.

Disadvantages of broadcasting

1. Some seeds go to waste as they are blown away by wind. Others may be eaten by birds hence reducing the number of seeds germinating.
2. The seed population is not even as many seeds may fall in one area and fewer seeds in another.

Under sowing

This is sowing grass or legume seeds in a field which is already planted with a crop such as maize or wheat. The grass or legume plants are grown in the spaces between the crops.

Advantages of under sowing

1. It reduces the cost of initial pasture establishment as it reduces the number of cultivations required.
2. It is more reliable.
3. It reduces the destruction of the soil structure because of the reduction of cultivation.

Disadvantage of under sowing

It is difficult to harvest the main crops especially when the under sown pasture has grown quite well.

Over sowing

This is the introduction of better grazing pasture species in unimproved grassland without destroying the existing forage cover. The existing cover protects the seedlings if a dry spell comes immediately after the seeds have germinated. During preparation of the seedbed

for over sowing, the existing forage should be reduced in height and density. This can be done by trimming the forage using a mower or grazing animals on that piece of land.

Advantages of over sowing

1. The existing forage protects the seedlings from direct sunlight.
2. The pasture is improved as a different and better species of pasture is introduced into the soil.

Disadvantages of over sowing

1. If planted without mowing, the existing forage will prevent sunlight from reaching the germinating seeds and this may cause them to wither or become unhealthy.
2. The growing seeds compete with the existing pasture for nutrients and sunlight.

Vegetative propagation

When planning to establish pasture using vegetative planting materials, the farmer should prepare the land to a reasonable tilth. The seedbed should be clean and free from weeds at the time of planting. The vegetative material can be planted in rows along the ridges, or by band placement in rows. Sets of Napier grass stems can be placed end to end. The spacing of the vegetative material will depend on the type of the species and its growth habits.

Fig. 11.5 Napier grass grown in a field

Advantages of vegetative propagation

1. The superior traits in the parent crop are maintained. This ensures that the pasture produced is of high quality.
2. Large quantities of pasture can be produced easily and faster.
3. The pasture grown through vegetative propagation matures faster compared to the one grown using seeds.

Disadvantages of vegetative propagation

1. Since the pasture grows fast, there will be competition for nutrients from the soil.
2. The planting materials are bulky to transport and store.
3. They deteriorate quickly and thus cannot be stored for a long period before planting is done.
4. Genetic weaknesses and traits in the pasture are carried on in the pasture that is being grown.

Drilling

This is the sowing of pasture seeds using a seed drill. This is the best way of planting seeds for pasture as the seeds are immediately covered by soil. Fertiliser can also be placed at the same time the seeds are being sowed into the soil.

Advantages of drilling

1. Seeds are sown at the correct depth.
2. Uniform spacing is maintained.
3. The seeds required are less than those used in broadcasting.

Disadvantages of drilling

1. It requires a skilled person to operate the seed drill.
2. The seed drill required for sowing is expensive.

Activity 11.3 Researching on methods of pasture establishment

(a) Find out the methods that farmers from your school use to establish pasture on their farms.
(b) Ask them the advantages and disadvantages of each method of pasture establishment and take down notes.
(c) Discuss your findings in class.

Seed rate

We have seen that one method of establishing pasture is through use of seeds. Seed rate refers to the amount of seeds to be used per hectare of land. It is expressed in kg/ha. The seed rate can be determined by finding out the average weight of one seed multiplied by

the number of seeds per hole per row, against the total land area. Seed rate influences spacing and eventually the plant population.

Appropriate spacing and plant population is important as it will increase growth rate of pasture. It also ensures high yields of the pasture that has been grown.

Calculating number of seeds per given area

A farmer wants to plant maize on his 1 ha farm. One grain of healthy maize seed weighs 0.002 kg on average. He has prepared 20 rows on his piece of land each having 100 holes. Calculate the seed rate if he plants 2 seeds in each hole.

Solution:

$$\text{Seed rate} = \frac{\text{Average weight of one seed} \times \text{Number of seeds per hole} \times \text{Number of rows}}{\text{Number of hectares}}$$

$$\text{Seed rate} = \frac{0.002 \times 2 \times 20}{1 \text{ ha}} \times 100$$

$$= 2 \times 2 \times 2$$

$$= 8 \text{ kg/ha}$$

From the calculation above, the farmer will use 8 kg of seeds on his one hectare farm during planting. The spacing between each of the holes should be appropriate. This helps in ensuring proper plant population and prevents overcrowding. Plant spacing and population should be put into consideration when calculating seed rate to ensure the correct amount of seeds to be grown are used.

Activity 11.4 Calculating seed rate for different pastures

In groups of five, discuss the meaning of the term 'seed rate' and write it down in your note books.

Visit different livestock farms around your school and collect data on:

(a) average weight of seeds that the farmers use
(b) number of seeds planted per hole per row
(c) the total land area used for growing the pasture.

Using the data that you have collected, calculate the seed rate for the different pastures. Present your findings in class.

Factors affecting pasture seed rate

The amount of seed material to be planted per unit of land is determined by several factors. Therefore, the factors affecting pasture seed rate include the following.

- Size of the seed – Tiny seeds will have lower seed rates as compared to seeds which are bigger or larger in size due to their lower weight.
- Soil tilth – Tilth refers to the condition of the soil in relation to its ability to support pasture growth. A seedbed with suitable tilth promotes better germination rate hence requires a lower seed rate compared to soil with poor tilth.
- Growth habit of pasture – The pasture species which spreads or produces more shoots/ tillers should have lower seed rates.

- Method of sowing – Seeds which are planted by the broadcast method have higher seed rates compared to seeds which are drilled. This is because some seeds are blown away by wind or eaten by birds when broadcasting.
- Type of pasture – A mixed pasture should have a lower seed rate compared to a pure stand pasture. This helps to avoid over-competition for soil nutrients.
- Purity percentage – Pure seeds require lower seed rates than those that are not. Good seeds should be clean and free from contamination by foreign materials such as weed seeds, husks, hollow seeds, and seeds of other plants. These seeds have a high purity percentage and will have a high germination percentage thus having a low seed rate.
- Germination percentage – The number of seeds germinating out of the total number of seeds sown will give the germination percentage. The germination potential of the seed is a critical factor because seeds which are suspected to be of lower viability will require higher seed rates.

Activity 11.5 Discussing the factors affecting seed rate

(a) Your teacher will invite a resource person from any of the seed companies in Malawi. He/She will explain to you the factors that affect pasture seed rates.
(b) Observe the charts on the different types of pasture seeds. Ask the resource person questions where necessary.
(c) Take down notes during the discussion.

Methods of pasture seed treatment

Seed treatment refers to the process or act of treating or dressing seeds with a pesticide to protect the plants against fungal, bacterial and viral diseases when the seeds start germinating. This is done before planting. The seeds are also treated or dressed to speed up their rate of germination. The methods used in treating pasture seeds are:

- Hulling
- Scarification
- Inoculation
- Pelleting

Hulling

Hulling is the process of removing the outer covering or husks of a seed. The seeds that have been hulled absorb water quickly after sowing and thus germinate faster. The hulls usually increase the time taken for a seed to germinate. Legume seeds are usually hulled so that they grow quickly and not remain dormant in the soil.

Importance of hulling

1. Hulling ensures that the seeds grow quickly after they have been planted.
2. Absorption of water is fast if the seeds have been hulled.

Scarification

Scarification is a method used in weakening the seed coat or husks of the pasture seeds before planting them. This makes the seeds germinate quickly. Mechanically harvested or threshed pasture seeds are suitable for use as they have already been scarified during the

process. To avoid deterioration, seeds which are scarified should be planted as soon as possible.

Seeds can be scarified using the following methods:

1. Mechanical method – This method is used on small amounts of seeds. The seeds can be rubbed using sandpaper. On the other hand, they can be rubbed using timber on a rough cement floor or surface.
2. Hot water method – This is a method in which the seeds are immersed in hot water. This method is easy but one should monitor it very closely. The seeds should be immersed in boiling water for a few minutes and then removed. This is to prevent the seeds from getting cooked. They should then be sown immediately to prevent them from germinating before planting them.
3. Acid treatment method – This method involves the immersion of the pasture seeds into concentrated acid for a specific period of time. Sulphuric acid is normally used. This method is used on very small amounts of seeds and should be carried out in a laboratory.

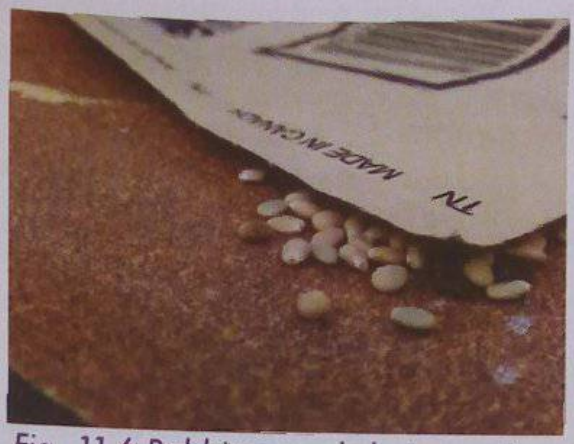

Fig. 11.6 Rubbing seeds between two pieces of sandpaper is a method of scarification

Fig. 11.7 Seeds soaked in hot water

Importance of scarification

1. It makes the seed coat permeable to water and air or gases.
2. The seeds are able to germinate fast when they have been planted because the germination process is not prolonged by seeds staying dormant in the soil.

Inoculation

Seed inoculation is the introduction of nitrogen fixing bacteria into the legume seed to help fix nitrogen in the soil.

Procedure for inoculating legume seed

1. Pour the legume seeds in a clean polythene.
2. Sprinkle drops of clean water or milk on the seed to cover every seed.
3. Scatter the inoculant evenly over the heap of moist seeds and mix thoroughly with clean sticks so that the inoculant covers every seed.

4. Spread the seed on a flat surface to dry for one or two hours under a shade.
5. When the seeds are dry, plant them using a suitable method.

Precautions during seed inoculation

1. Do not expose the inoculated seeds to direct sunlight as light may kill the nitrogen fixing bacteria.
2. Use only the inoculants with viable bacteria.
3. Inoculated seed should not come into contact with acidic fertilisers.

Importance of inoculation

1. Inoculation ensures that the Rhizobium bacterium is present in the soil to fix atmospheric nitrogen and into the pasture through the root nodules.
2. It ensures that there is an increase in the amount of bacteria available in the soil.

Pelleting

Pelleting is the process of coating seeds with materials or substances that are inert or lifeless to make them uniform in size and shape. The materials used dissolve as they absorb moisture after the seeds have been planted. This ensures that oxygen reaches the seeds faster thus accelerating germination. The seedlings also emerge at the same time ensuring uniform growth. This ensures that there is more accurate sowing and that a few seeds are used during the planting process.

Fig. 11.8 Unpelleted and pelleted seeds

Importance of pelleting

Pelleting is important because of the following reasons.

1. It increases the availability and penetration of oxygen in the seed.
2. It ensures there is accurate spacing of the seeds when they have been planted.
3. The amount of seeds used will be less as it ensures a low seed rate.

Activity 11.6 Treating pasture seeds using different methods

(a) In groups of eight, research on the methods used in pasture seed treatment and the importance of each method.

(b) Discuss your findings in the group and take down notes.

(c) Your teacher will organise to get some pasture seeds. Treat some of the pasture seeds provided to you using the following methods.

- Hulling
- Scarification
- Inoculation
- Pelleting

(d) Plant both sets of seeds, the treated ones and the untreated ones on the school farm. Write down your observations regarding their germination.

Proper time for pasture establishment

Pasture should be established during the planting season. Pasture seeds should be sown early enough in the season to achieve better results. This is the period when the soil is still warm. The young seedlings benefit from this as there is enough nitrogen in the soil that will ensure faster growth.

In vegetative propagation, the stems and root cuttings should be planted when there is enough moisture in the soil.

Activity 11.7 Planting pasture using an appropriate method

(a) In class, discuss the proper time for establishing of pasture. Record this in your notebooks.

(b) In groups of five and under the guidance of your teacher, visit the school farm and prepare the land.

(c) Choose a suitable method of pasture establishment and plant pasture using the method you have chosen.

Pasture management

The main purpose of pasture management is to sustain livestock productivity. Therefore, there is need to improve and maintain the pasture for high livestock production. Pasture management includes all the practices undertaken to maintain the productivity of pasture.

For the successful maintenance of high yields from the pasture on the farm the farmer should observe the following.

- Production of sufficient amounts of herbaceous vegetation to meet the feeding requirements of the animals throughout the year.
- The pasture produced on the farm should be eaten with no wastage.
- The pasture should be utilised when its quality is sufficiently high for high yields from the animals.
- Sustainable methods of pasture managment should be employed.

Activities in management of pasture

There are several activities that are involved in the management of pasture.

1. Application of manures or fertilisers

The correct type and amount of fertiliser should be applied during pasture establishment to ensure proper growth rate of the pasture. For example, 120 – 250 kg of triple superphosphate should be applied per hectare of land at the time of planting. 190 kg of nitrogen fertiliser should then be applied 8 – 10 weeks after planting the pasture. However, the application of fertilisers will depend on the fertility of the soil. Therefore, the soil should be tested to determine its level of fertility.

Fig. 11.9 Application of manure on pasture land

Top dressing the pasture with organic manures or fertilisers is a vital requirement. Top dressing should be done at the onset of the rains, with split applications of nitrogen fertilisers.

2. Weed control in pasture

Weed control is a very important pasture management activity. Weeds compete with pasture for nutrients, moisture and light. They smother pasture leading to pasture failure. Some weeds are poisonous to livestock and others may have thorns which cause injuries to the animals as they graze. Lastly, weeds lower the productivity of pasture and when eaten by livestock, they lower their productivity too. For example, Mexican marigold taints milk when eaten by animals. Therefore, it is important to weed pasture land before and after planting. This can be done by:

- clearing the pasture land of all vegetation and weeds before the planting process
- planting seeds that have a high purity percentage as this ensures that the seeds are not contaminated with weeds or weed seeds
- uprooting the weeds from the growing pasture mechanically using the hand
- applying herbicides that are not harmful to the livestock or the pasture.

3. Controlling pests and diseases

Just like crops, pasture grasses and legumes can be attacked by pests and diseases. The pests and diseases attack livestock leading to stunted growth, low productivity and in extreme cases, they may cause death. Pests also damage pasture.

Fig. 11.10 Pasture infected by pests

A farmer should be on the look-out for any signs of pest or disease infestation in livestock as this may be a sign of pasture that is affected by pests and diseases. Rotational grazing should also be practiced to reduce build-up of pests and diseases in the pasture.

Pasture should be sprayed with chemical substances that are not harmful to the health of the animals. Spraying ensures pess and diseases are eliminated from the pasture.

4. Grazing livestock

The grazing of livestock should be controlled to ensure that pasture is not destroyed. A farmer should ensure that pasture is not overstocked to reduce overgrazing, nor should the pasture be under stocked.

Controlled stocking is an important aspect of pasture management and it is the overriding factor in the process of pasture management. Both overstocking and understocking are undesirable as they will lead to pasture deterioration. Understocking leads to the accumulation of inedible materials in pasture. The forage also gets woody and weeds increase thereby preventing growth of new pasture. Therefore, the right number of livestock should be grazed on a certain area of pasture at any given time.

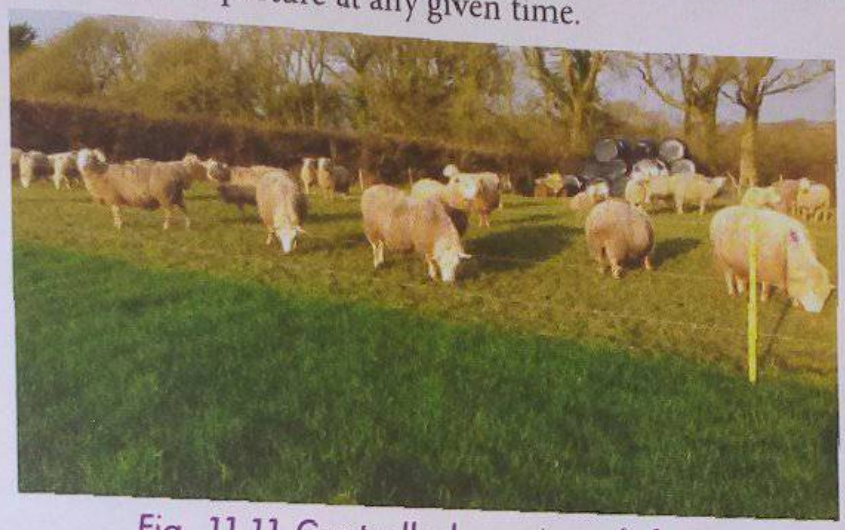

Fig. 11.11 Controlled grazing of sheep

5. Controlling burning of pasture

During the dry season, many farmers burn pasture to clear the land in readiness for the planting season when new pasture is grown. This is not a good practice as burning of pasture leads to the death of beneficial micro-organisms in the soil. There will be reduced microbial activity which leads to soil infertility. The soil structure is also destroyed. Therefore, the pasture land will not be as productive as it should be. Burning of pasture should be avoided.

Activity 11.8 Managing pasture

You have learnt about pasture management in the sub-topic above. In groups of five and under the guidance of your teacher, practice managing the pastures that you had established earlier on the school farm.

Grazing systems in pasture management

There are various grazing methods that farmers adopt. These methods are discussed below.

Zero grazing

In this system, the animals are confined in their sheds and the forage is cut and brought to them. The system has gained popularity in Malawi in the small scale dairy industry where land is limited.

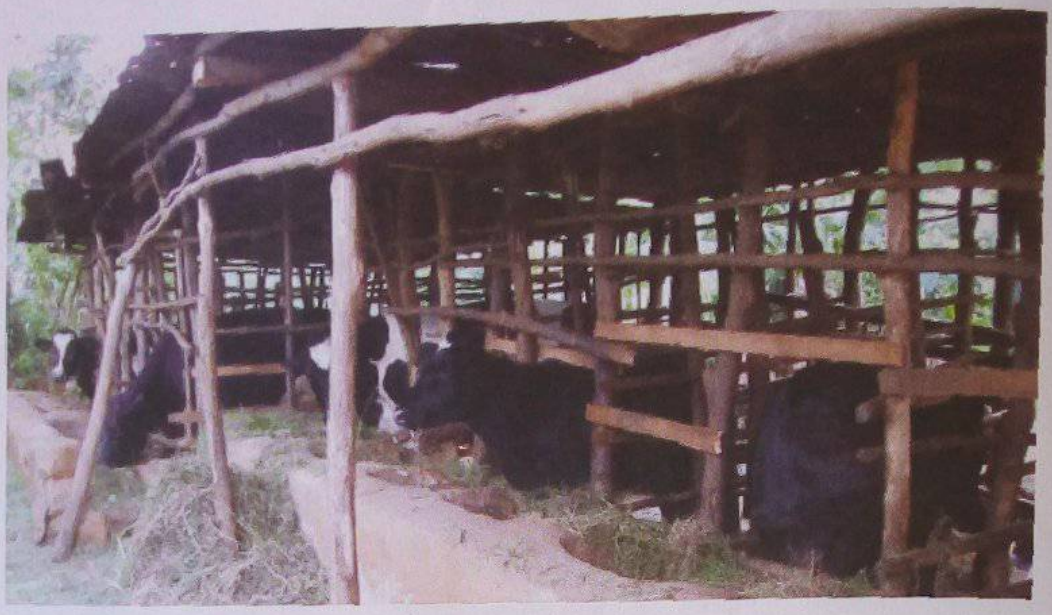

Fig. 11.12 Zero grazing

Advantages of zero grazing

1. Forage intake is uniform and it is easy to ration fodder for livestock.
2. Greater yields are achieved from the livestock.
3. There is reduction in energy loss as livestock do not walk long distances looking for pasture.
4. It allows higher stocking rate in relation to the amount of land available.
5. It allows close supervision on feeding and general management.

Disadvantages of zero grazing

1. The cost of establishing the zero grazing unit is high.
2. There are problems of obtaining bedding material and establishing an appropriate disposal system.
3. This methods requires full time supervision.

Rotational/paddock grazing

This is a system where more than one piece of land is used in grazing livestock. The land is divided into sections and livestock are grazed in one area then moved to another once the pasture in the current area is exhausted. The pasture land is given time to re-grow as the livestock feed on pasture in another area of land. The plots in which the land is divided into are normally referred to as paddocks.

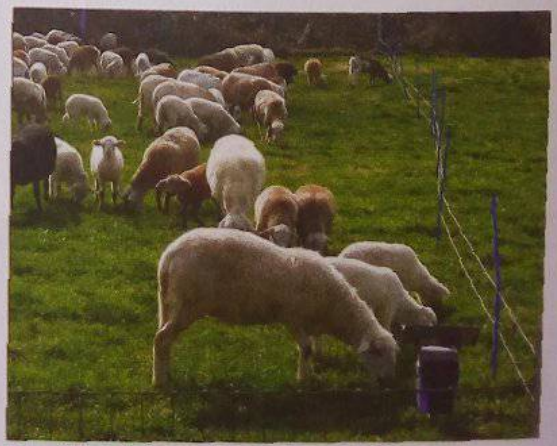

Fig.11.13 Rotational paddock grazing

Advantages of rotational grazing

1. It breaks the life cycles of internal parasites thus ensuring their control.
2. Pasture is utilised at the correct stage of growth when it is highly nutritious.
3. It allows excess pasture to be conserved as hay and silage for later use.
4. Different management operations such as fertiliser application can be carried out in the paddock when not in use to improve the productivity of the soil.
5. Since the paddocks are fenced, animals infected with diseases can be separated from the healthy ones hence reducing the spread of diseases.
6. There is even and controlled grazing of the pasture.
7. Animal wastes such as dung and urine are well distributed and decompose into humus making the pasture fertile.

Disadvantages of rotational grazing

1. It requires fencing and paddocking which may be expensive for some farmers.
2. The number of livestock kept in this system of grazing should be high in order to utilise the pasture efficiently.
3. It requires large tracts of land.

Strip grazing

It is similar to rotational grazing. However, it involves giving livestock a new place to graze daily. The paddocks are subdivided into strips using a movable electric fence. This is used to ensure that the livestock graze only in the strip allocated. It is an ideal system for utilising high yielding pastures and for rationing the consumption of high quality fodder.

Fig. 11.14 Strip grazing cattle in a field

Advantages of strip grazing

1. It minimises bloating in livestock since it helps in reducing the intake of pasture by livestock.
2. It gives more productivity per unit of land than the regular rotational grazing.
3. The pasture is utilised more efficiently.
4. It is comparatively cheaper than constructing the paddock.

Disadvantages of strip grazing

1. There must be a source of electric power which is not available everywhere.
2. There is the extra cost of electricity which the farmer must meet.

Continuous grazing

This is a system of grazing whereby the animals are left to graze freely on the land without any restrictions. The livestock are often grazed in one big area of land. This system is common in areas where communal grazing is practiced. Most farmers in Malawi use this system of grazing as it is the least expensive.

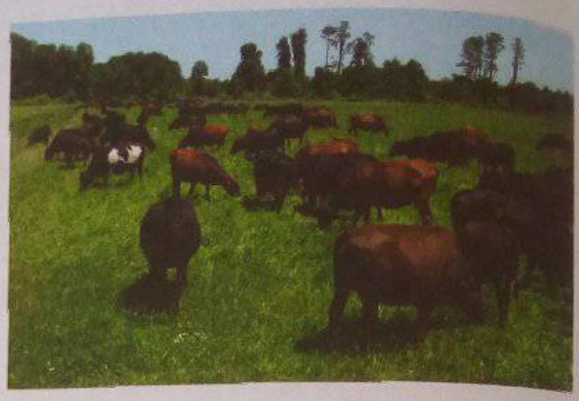

Fig.11.15 Grazing cattle freely on a piece of land

Advantages of continuous grazing

1. There is minimum or no investment involved in the establishment of the pasture.
2. The productivity of livestock raised under this system is higher than the one raised under the other grazing systems if there is enough pasture.
3. It is simple to implement and manage.
4. It is the least expensive.

Disadvantages of continuous grazing

1. It is difficult to control grazing as livestock graze unevenly. They feed on the forage that they like and leave what they do not like. It is also difficult to control understocking and overstocking.
2. The quality and quantity of the pasture is reduced.
3. There is a build-up of pests and diseases in pastures where continuous grazing is practiced.
4. Weeds and other undesirable plants grow in large numbers.
5. Soil erosion may occur if the pasture is overstocked.

Deferred grazing

This is a system of grazing where livestock are delayed from grazing in a pasture because they already have enough pasture to feed on. They are later fed on this pasture when there is shortage of forage, especially in the dry season.

Advantages of deferred grazing

1. It reduces overgrazing.
2. It leads to an increase in the stocking rate since pasture will be available even when there is shortage.

Disadvantages of deferred grazing

1. Long delays in feeding livestock on the pasture may cause the forage to become woody and thus unsuitable for livestock.
2. It leads to a reduction in the grazing season and period of grazing.

Activity 11.9 Observing grazing systems

(a) Your teacher will organise for you a visit to different livestock farms. Observe the grazing systems used in feeding livestock on the farms that you will visit.

(b) Write short notes on what you have observed during your field trip.

Pasture conservation

The idea behind pasture conservation is to keep the excess forage for future use and to ensure continued distribution or supply of fodder to livestock throughout the year. It also aims at keeping the pasture safe from deterioration.

Efficient pasture utilisation includes harvesting of the forage when its nutritive value is at the maximum, and using the pasture without wastage.

Methods of pasture conservation

There are three main methods of conserving fodder for future use

- Hay making
- Silage making
- Foggage

1. Hay making

The process involves reducing the moisture content of the forage crops that have been cut. This can be done either naturally or artificially. It allows storage of food for livestock without the risk of deterioration through fermentation, mould formation or decomposition.

Fig. 11.16 Bales of hay

At the time of cutting the forage to make for hay, the moisture content ranges between 60 – 80 percent. This must be reduced to about 20 percent before hay can be stored in bales or down to 16 percent for hay that will be left loose. Avoid cutting immature crops which are too succulent. The farmer should avoid using immature crops to make hay as they are too succulent.

Procedure for hay making

(a) Cut the crop at its highest nutrient value. The crop can be cut by hand equipment using sickles or tractor mounted mowers where available. Aim at making the hay during dry weather.

(b) Allow the crop to dry in the field for 24 hours depending on the weather condition.

(c) Spread out the cut forage on a dry surface to allow further drying of up to 48 hours before baling. Baling should be done 72 hours after cutting. There are mechanised baler machines for making of hay which are faster and efficient at curing hay.

(d) Where mechanised balers are not available, the forage should be allowed to initially dry for 48 hours after cutting before being turned over. Thereafter, the hay is allowed to dry for a further 48 – 72 hours before being tied in bundles using a string and then stored.

It is important that the bales of hay are stored when ready without delay to reduce losses that may occur due to poor handling or deterioration. One can determine when hay has dried appropriately and is ready for storage by twisting a handful of hay. It should not produce any moisture.

2. Silage making

Silage making is a process in which the forage is preserved with high moisture content through fermentation in air tight conditions. Silage is the product resulting from natural fermentation of green plant material in the absence of air. For the purpose of preservation, plant material should be cut at their highest nutrient level for use during seasons of scarcity when fresh forage is not available. Silage may also be made to conserve the excess fodder which cannot all be consumed when fresh.

Procedure for silage making

(a) Cut the crop at the correct maturity stage or maximum nutrient content.

(b) Allow the crop to wilt to acceptable moisture level.

(c) Chop the forage to reasonable sizes and fill in a silo.

(d) Spread the material in the silo evenly and compact well with heavy equipment.

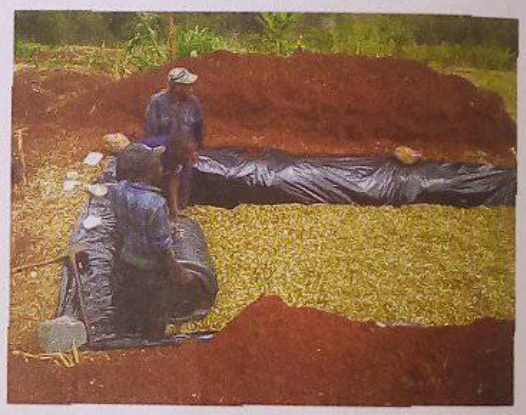

Fig. 11.17 People making silage

(e) Fill the silo up to about 1 metre on the first day.

(f) Before starting to fill the silo on the second day, check the temperature which should be about 32.2°C. Higher temperatures mean more compaction is needed.

(g) Complete the filling on the third or fourth day and cover the silo to ensure that no air gets in.

(h) Dig a trench around the silo to keep surface water away.

The formation of sugar in the plant by bacteria results in acid production which leads to the preservation of silage. Lactic acid found in good silage is formed. To encourage the formation of lactic acid, molasses can be added to the cut forage in the silo. This also helps to improve the quality of the silage.

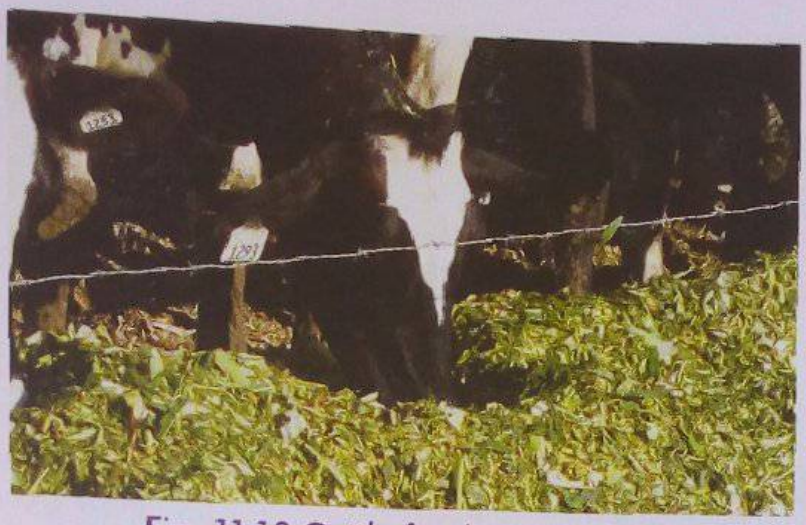

Fig. 11.18 Cattle feeding on silage

3. Foggage

Foggage is standing hay or pasture (mainly grass) that is left to grow and dry up in the field for direct grazing during the dry season. The livestock are grazed directly on the dry grass when there is shortage of pasture. Foggage may be from natural pasture or from an established pasture.

Fig. 11.19 Foggage

Activity 11.10 Conserving pasture

(a) Your teacher will take you to visit a livestock farm around your school. Observe carefully as the resource person demonstrates how to make hay and silage.
(b) Write down the steps followed when making hay and silage.
(c) Your teacher will help you collect materials needed for pasture conservation.
(d) In groups of five, practise pasture conservation by making hay and silage.

Factors that affect quality of conserved pasture

Pasture can be conserved in different forms such as hay or silage. Factors that affect the resultant quality of the conserved pasture include the following.

1. Leafiness of pasture – Pasture that is very leafy after growth produces good quality hay or silage. Pasture that is woody produces poor quality hay or silage.
2. Age at which pasture is cut – The age at which the pasture has been cut has a direct bearing on quality of conserved pasture. When cut at the right time, pasture normally has high nutrient levels meaning the conserved hay or silage will have high nutrient content and dry matter content. When cut at a young stage, both the nutrient

content and dry matter content will be too low. Similarly, when the pasture is old, the nutrient content will be low while dry matter content will be too high.

3. Moisture content – The percentage of moisture content in conserved hay will affect its quality. Hay with high moisture content will turn mouldy and will decompose. On the other hand, very dry hay with low moisture content will break during handling hence it will be of low quality.

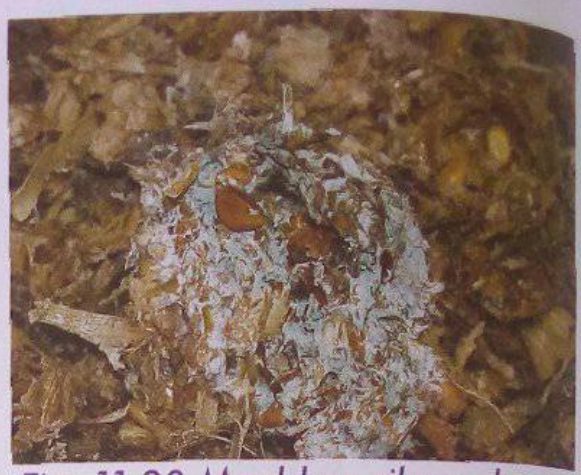

Fig. 11.20 Mould on silage due to poor storage

4. Presence of foreign materials – The presence of foreign materials such as stones and twigs in conserved pasture lowers its quality. Clean hay or silage is of higher quality.

5. Method of storage – If the conserved pasture is stored poorly, the quality will be lowered. For example, if hay is stored in a room with a leaking roof, will decompose and the quality will be lowered. But if the house does not leak, the quality will remain high. If the silo pit used for making silage is not made airtight, there will be multiplication of bacteria which will produce low quality silage.

6. Weather conditions – When the weather is very wet, it is more difficult to prepare and keep high quality hay than when it is dry. It is easier to conserve pasture during dry weather conditions.

7. Pasture species used – The pasture species that is used directly affects the quality of conserved pasture. A pure stand of legumes or a mixed grass-legume pasture will produce high quality feed than using grass alone. Some grass species are also more nutritious than others.

Activity 11.11 Discussing the factors that affect the quality of conserved pasture

(a) In groups of five, discuss the factors that affect the quality of hay and silage.
(b) Present your findings in class.

Practical activities

1. Visit farms and areas around your school and carry out the following activities.
   - Collect different pasture species.
   - Identify the pasture species collected.
   - Preserve the samples of the species collected.
2. While on the field visit, find out the nature of fodder and pasture crops that most farmers use in feeding their livestock in your local area.

3. As a class, grow a fodder crop and practice how to make hay and silage in the school farm.

4. If the school has livestock, feed them on some of the green fodder, hay or silage you have made.

Summary

- Pasture refers to the grasses or fodder crops grown purposely for feeding livestock.
- Pasture can be classified on the basis of type as pure stand or mixed stand pasture.
- A mixed stand is one that has both grasses and legumes growing together.
- In addition to playing an important role as livestock feed, pasture also acts as cover for the soil which prevents soil erosions improves soil fertitlity, helps to maintain soil structure and reduces build-up of pests and parasites in livestock.
- Indigenous pasture refers to naturally growing pasture that is common in communal grazing fields while exotic pasture refers to the artificially established or grown pasture.
- Pasture can be established through broadcasting seeds, undersowing, oversowing, vegetative propagation and seed drilling.
- Management of pasture involves application of fertilisers and manures, weed control, control of pests and diseases, grazing on by animals and control of burning.
- The most common grazing systems are zero grazing, rotational/paddock grazing, strip grazing, continuous grazing and deferred grazing.
- Pasture conservation is the practice of preserving the extra pasture that is produced for future use. The methods used to conserve pasture include hay and silage making.
- The quality of the conserved pasture may be influenced by leafiness of pasture, age of cutting, moisture content, weather conditions, method of storage, presence of foreign materials and the species of pasture used.
- Care must be taken to prevent loss of quality of the pastures before and during conservation.

Revision questions 11

1. Differentiate between mixed pasture and pure stand pasture.
2. Explain the factors that should be considered before establishing a pasture.
3. (a) What is seed inoculation?

   (b) Describe the procedure for inoculating seeds.
4. (a) Explain what deferred grazing is.

   (b) Give the advantages and disadvantages of deferred grazing.

5. Outline the procedure of establishing pasture from vegetative materials.
6. State the importance of pasture.
7. (a) List the types of pasture.
   (b) Discuss the methods of pasture establishment.
   (c) Outline the advantages and disadvantages of each method of pasture establishment.
8. (a) What is pasture management?
   (b) Identify the proper time for pasture establishment.
   (c) Evaluate the activities involved in pasture management.
9. Describe the following fodder crops.
   (a) Napier grass
   (b) Guatemala grass
   (c) Sorghum
   (d) Lucerne
10. Describe the factors that affect the quality of conserved pasture.

Chapter 12

Mango production

Introduction

Areas of medium and low altitude in the tropics are most suitable for mango production. Mangoes are grown for local consumption and export. Mangoes originated from South East Asia, India and the Philippines. They were introduced in the southern Africa region around the 14th century and has since gained popularity. Mangoes are among the crops exported to the European markets from Malawi.

Success criteria

By the end of the chapter, you must be able to:

(a) state the importance of fruits
(b) identify different mango varieties
(c) select a suitable site for mango production
(d) prepare a site for transplanting mango seedlings
(e) transplant mango seedlings
(f) describe how to weed the mango orchard
(g) identify pests that attack mangoes
(h) explain how to control pests that attack mangoes
(i) identify diseases that affect mangoes
(j) explain how to control diseases that affect mangoes.

Importance of fruits

Why are fruits important? Fruits are grown in Malawi for their:

- Nutritional value
- Economic value
- Socio-economic value.

Nutritional value of fruits

Fruits are low in fats, cholesterol, sodium and calories. They are rich in sugars (carbohydrates) and in vitamins A, B and C. They can be eaten as a fruit or processed to make different juices. Fruits are essential in the diet as they keep people healthy.

A big percentage of a fruit is water. *Fruits* therefore help to keep the body hydrated. They lower the risk of one getting illnesses and diseases because they contain nutrients and vitamins that protect the body from diseases such as cancer, diabetes, stroke and heart

related diseases. They lower the cholesterol levels in the body, clear the skin by opening pores and eliminate pimples.

Fruits such as mangoes contain vitamin A, which improves eyesight by preventing night blindness. They also prevent dry eyes.

Fruits give the body energy since they are rich in carbohydrates. They are also rich in fibre and thus help in the process of digestion.

Fig. 12.1 Different types of fruits

Economic value of fruits

Farmers produce fruits as a source of income. The fruits are also exported earning the country foreign exchange. Fruit trees can also be used as a source of wood once they become unproductive. The wood is sold and used in making furniture.

The barks of mango trees contain tannin and thus can be sold and used in the process of tanning hides.

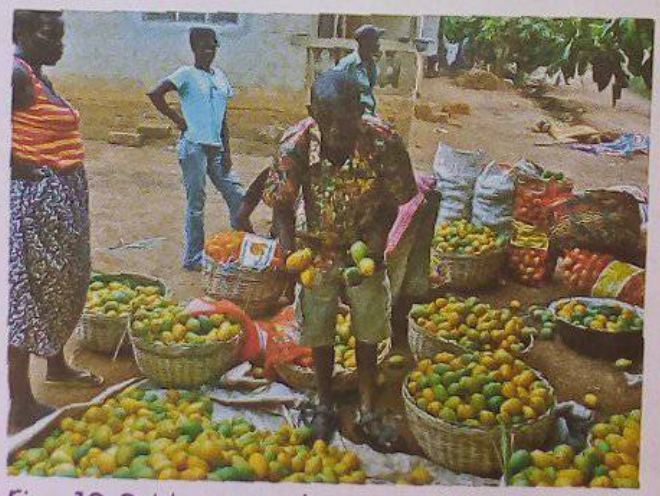

Fig. 12.2 Mangoes being sold at a market

Socio-economic value of fruits

Fruits are also grown for their socio-economic value. Fruit trees provide shade and thus people can sit under the trees while resting. They also prevent soil degradation as their roots hold soil together and prevent soil erosion. The trees purify the air that we breathe as they take in carbon dioxide and release oxygen.

Fruits also have a medicinal value as their nutrients protect the body against diseases such as cancer, diabetes, stroke and heart related diseases. They also help in clearing the skin and preventing night blindness in human beings.

Activity 12.1 Researching on the importance of fruits

(a) In pairs, find out and discuss the importance of fruits in regard to the following:
- Nutritional value
- Economic value
- Socio-economic value

(b) Record your findings and present them in class.

Varieties of mangoes

There are over 350 varieties of mangoes in the world. In Malawi, the common varieties are:

- Ngowe
- Keitt
- Kent
- Apple

Ngowe

This variety of mangoes is commonly grown in the coastal regions of Malawi in the medium altitude areas. It matures early and produces yellow fruits.

Fig. 12.3 Ngowe mangoes

Keitt

This variety of mangoes has round oval fruits with yellow to light red colour.
The flesh is orange to yellow in colour. It is fibreless except the area that is close to the seed. The tree is of medium size. It is late in maturing and highly productive depending on how it is managed.

Fig. 12.4 Keitt mangoes

Kent

This variety of mangoes has oval-shaped fruits with greenish yellow skin. The fruits mature very late. The flesh is fibreless, sweet and has good flavour. It is susceptible to black spot diseases.

Fig. 12.5 Kent mango fruit and tree

Apple

The apple variety mango grows well in the coastal and lowland areas. It is susceptible to rust in high altitude areas. It has round, apple-shaped fruits whose flesh is yellow to orange in colour.

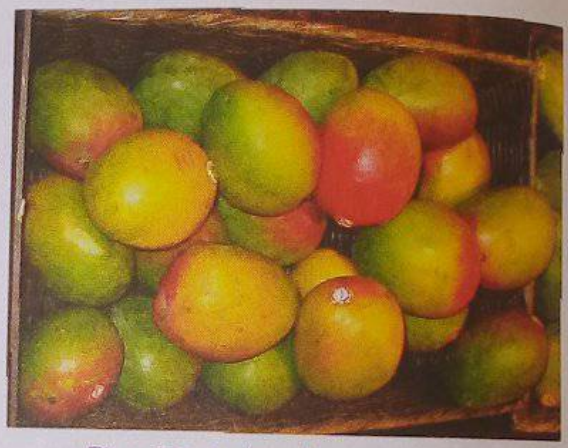

Fig. 12.6 Apple mangoes

Activity 12.2 Discussing characteristics of different mango varieties

(a) Your teacher will provide you with samples of different varieties of mango fruits. Observe the mangoes and discuss the characteristics of each variety.
(b) Record the characteristics in your notebooks.
(c) Cut the mangoes and taste them. Record in your note books how each variety tastes.

Site selection for mango production

A site that is suitable for mango production should be identified first before planting them. There are various factors that should be considered when selecting a site for mango production.

1. Ecological requirements – Mangoes do well in the lowland to upper middle altitude areas of 1500 m above sea level. Apple mangoes and Ngowe will do well in areas whose altitude is below 1000 m above sea level.
2. Temperature – Mangoes require a temperature of 15^0 C. At lower temperatures, the quality of the fruits declines.

3. Rainfall – An annual rainfall of 850 – 1000 mm will be adequate for mango production. Flower production is facilitated by a dry or cold spell. Rain during flowering reduces fruit set. An established mango tree is relatively drought resistant provided the tap roots have access to the water.
4. Soil requirements – Mango trees require a wide range of soil types. However, a deep fertile soil is preferable. The soil should be loamy and adequately drained.

Activity 12.3 Identifying suitable sites for mango production

(a) Discuss the factors that should be considered when selecting a site for mango production.
(b) Under the guidance of your teacher, take a walk in your school farm and identify a site that is suitable for mango production.

Preparing a site for transplanting mango seedlings

1. Land clearing – The site where mango seedlings will be transplanted to should be well cultivated. Bushes and weeds should also be removed and roots uprooted. The land should be cleared completely.
2. Making planting holes – Prepare holes 60 cm by 60 cm for planting. The recommended spacing for mango holes is 12 m by 12 m. Closer spacing of the seedlings yields higher fruits when they are fully grown. After a period of 10 – 15 years, closely spaced trees may have the canopy touching each other.
3. Manure and fertiliser application – Mix the topsoil with about 20 kg of well decomposed manure and 125 g of triple sulphate or ammonium phosphate before filling the hole. Fill the hole halfway with topsoil.

Fig. 12.7 Planting holes made for mango seedlings

Activity 12.4 Preparing a site for transplanting mango seedlings

In groups of five and under the guidance of your teacher, select a site suitable for growing mangoes. Prepare the site you identified in Activity 12.3 in readiness for transplanting mango seedlings by:
(a) clearing the land
(b) making the planting holes
(c) applying manure.

Transplanting mango seedlings

1. Water the hole before transplanting mango seedlings to ensure that there will be root and soil contact after transplanting.
2. Lift the seedling slowly and carefully from where it has been grown and put it into the hole.

3. Fill the hole with soil mixed with compost manure. Do this carefully and use a trowel to avoid damaging the seedling.
4. Water the seedling directly immediately after transplanting.
5. Mulch can be added around the seedling to reduce erosion and to conserve moisture and soil. Use dry grass or leaves.

Activity 12.5 Transplanting mango seedlings

(a) Your teacher will provide you with mango seedlings and farm tools. He/she will demonstrate to you how to transplant mango seedlings.
(b) Practise transplanting the mango seedlings into the holes that you prepared.
(c) Mulch the area around the mango seedlings using dried grass or leaves.

Weeding the mango orchard

The site where the seedlings have been transplanted so that they can grow permanently is referred to as an orchard. There are various methods of weed control. These include:

- biological weed control
- chemical weed control
- legislative weed control
- mechanical weed control

You learnt about each of these methods of weed control in Form 2. In weeding mango orchards, the mechanical method of weed control is usually adopted.

Weeds can be removed manually using the hands by pulling them. This method is used when the mango plants are still young. Small hand tools such as the hoe can be used in weeding too.

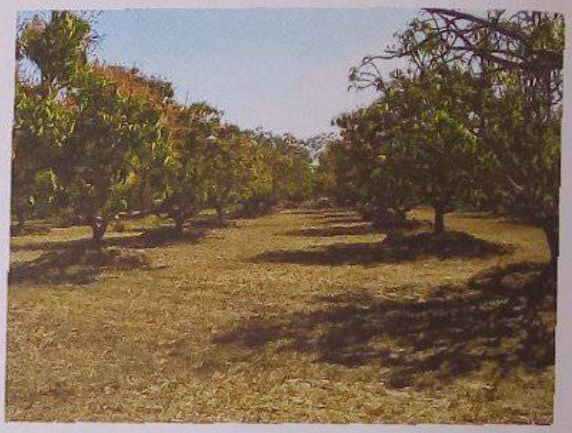

Fig. 12.8 A mango orchard

Once the mango plants are mature and have become of age, other methods of mechanical weed control such as the tractor-drawn tiller method can be used in controlling weeds.

Mulching the areas around the trees helps to control weed and conserve moisture.

Activity 12.6 Weeding a mango orchard

(a) You learnt the various methods of weed control in Form 2. Review and discuss each of these methods in class.
(b) Select an appropriate method of weeding a mango orchard from the methods you have discussed in (a).
(c) Your teacher will take you on a visit to a mango farm near your school. The resource person will demonstrate to you how to weed a mango orchard.
(d) Practice weeding a mango orchard.

Pests that attack mangoes

What are pests? Pests are insects or animals that attack crops. The pests that attack mangoes include:

- fruit flies
- mango scales
- red-branded
- mango stone weevil
- thrips.

Fruit flies

Fig. 12.9 A fruit fly

These pests look like wasps. They are red-brown in colour with yellow marks. The female fly usually bores holes in the mature mango fruits and lays eggs there. The eggs hatch after 2 – 3 days and develop into larvae. They destroy the fruits by feeding on the flesh.

Controlling fruit flies

1. Use approved chemicals to spray the fruits to protect them from attack.
2. Fallen fruits should be collected to prevent them from accumulating under the tree. They will provide a breeding ground for the fruit flies.

Mango scales

Fig.12.10 Mango scales on a mango leaf

These are small insects that vary in colour and shape. They are immobile insects. The female insects have neither wings nor legs. They usually resemble small shells. They lay eggs under the shell which hatch and move into the fruit and then they do not move anymore. They usually suck the juice or sap from parts of the mango plant. The mango scales cause yellowing of the leaves and poor growth in the mango plant. The attacked fruits usually drop before growing to maturity.

They also secrete honeydew which helps in the development of sooty mould on leaves.

Controlling mango scales

1. The biological control method should be used. Predators such as ladybirds and wasps should be introduced to feed on the insects.
2. The trees should be sprayed with approved chemicals to avoid damaging the fruits and mango plant.
3. If the signs of infection are detected early, the affected branches, leaves and fruits should be trimmed and removed.

Mango stone weevil

They are also known as the mango seed weevil. They are dark brown or black in colour with grey markings. The female weevils lay eggs on the fruits that are ripening. They make holes in the fruit and feed on the pulp, seed coat and they later on cause damage on the seed or stone. The pulp is usually discoloured in the area that is affected.

Fig. 12.11 A fruit affected by the mango stone weevil

Controlling mango stone weevil

1. Affected fruits should be plucked and removed.
2. The mango plants should be sprayed with approved insecticides.
3. The weevils that are hibernating can be controlled by digging the soil. This will expose the weevils and thus cause their death.

Fig. 12.12 Red-banded thrips

Red-banded thrips

These are insects with light coloured bodies. They have a red band around the abdomen hence their name. The eggs are laid on the lower surface of the leaf and then covered with a fluid. The fluid dries and forms a cover that protects the eggs. They then hatch and suck sap from the leaves. They like feeding on the midrib. In extreme or severe cases, they can also attack the fruit.

Controlling red-banded thrips

1. Constantly check the lower surfaces of the leaves for any signs of infection.
2. Spray the mango plant with the appropriate insecticide if you detect any sign of infection.

Activity 12.7 Identifying and controlling pests in mangoes

(a) Your teacher will take you on a visit to a nearby mango orchard. Identify the trees infected by pests and carefully observe the pests.

(b) Identify the pests and discuss with your group members the ways of controlling the pests.

(c) With the help of the farmer, identify a particular pest and control the pest using an appropriate method.

Diseases that affect mangoes

Diseases that affect mangoes have specific signs and symptoms. The common diseases are:

- anthracnose.
- powdery mildew.

Anthracnose

It is also known as blossom blight. It is a fungal disease. This is the most common disease affecting mangoes. The affected leaves, stems and fruits have dark sunken spots. The unripe mangoes do not show any signs of infection until they become ripe. Pinkish spots form on the fruits and they later become black. The fruit may get punctured in the areas affected.

Fig. 12.13 Mango leaves and fruits affected by anthracnose

Controlling anthracnose

1. The spotting in leaves is not very serious. However, spotting in leaves should be controlled through spraying with approved fungicides.
2. The mango orchard should be kept clean through pruning.
3. The leaves and branches that have the diseases should be trimmed and burnt.

Powdery mildew

This is a serious disease that affects almost all species of mangoes. It is a fungal disease seen as a powdery substance that is found on leaves, the midrib, young fruits and the flowers. The disease reduces the yields of the mango plant since the affected fruits and flowers usually drop prematurely.

Fig. 12.14 Powdery mildew on leaves of mangoes

Controlling powdery mildew

The disease can be controlled by spraying the orchard using appropriate fungicide. The instructions on the fungicide from the manufacturer should be followed strictly.

Practical activities

1. Having learnt about the various diseases that affect mangoes, visit a mango orchard near your school under the guidance of your teacher.
2. Look at each tree in the orchard and identify the trees with diseases. Observe the affected trees carefully and identify the diseases affecting the trees.
3. Use appropriate methods to control the diseases identified. Do this with the aid of resource persons from the orchard.

Summary

- Production of mangoes earns Malawi foreign exchange that is used for economic development.
- Mangoes are highly nutritious fruits that are consumed across the world.
- Fruits are low in fats, cholesterol, sodium and calories but they are rich sugars (carbohydrates) and in vitamins A, B and C.
- Mangoes are eaten as a fruit or processed to make different juices. Fruits are essential in the diet as they keep people healthy.
- Economically, mangoes are a source of income as they are sold to earn income. Socially, they provide shade for resting under and they help in purification of the air we breathe in.
- There are over 350 varieties of mangoes in the world. In Malawi, we have four varieties, namely Ngowe, Keitt, Kent and Apple mangoes.
- Mangoes thrive best in areas receiving 850–1000 mm of rain per year, with temperatures of 15°C, at an altitude of 1500 m above sea level. Deep, well-drained fertile soils are preferable.
- During site preparation, the land should be prepared to the required tilth, and holes measuring 60 cm by 60 cm at distances of 12 m by 12 m dug.
- During transplanting, the seedlings should be lifted carefully with soil, and placed into the planting holes. The holes should then be filled with soil mixed with compost and covered gently.
- Watering must be done regularly to ensure the seedlings do not dry off. Control of weeds in mangoes is done using biological, chemical, mechanical or legislative weed control methods.
- Common pests that attack mangoes include the mango scales, fruit flies, mango stone weevils and red-band thrips. Anthracnose and powdery mildew are the most common diseases that affect mangoes.

Chapter 13

Breeds of cattle

Introduction

Livestock production represents a very important aspect of farming in Malawi. While some communities grow crops only, the majority of farmers in Malawi practice mixed farming.

Due to changing climatic conditions, some farmers keep livestock as their only source of livelihood. Cattle are commonly kept by large and small scale farmers for subsistence and commercial purposes. There are different breeds of cattle that are kept by farmers and are used for different purposes.

Success criteria

By the end of the chapter, you must be able to:

(a) list breeds of cattle for dairy and beef production

(b) describe the characteristics of cattle breeds for dairy and beef production

(c) describe management practices for beef and dairy production

(d) identify a suitable house for cattle

(e) describe how to construct an appropriate house for cattle

(f) identify suitable feeds for cattle

(g) identify diseases of cattle

(h) explain how to control diseases of cattle

(i) identify parasites of cattle

(j) explain how to control parasites of cattle.

Breeds of cattle

The breeds of cattle that are kept by farmers in Malawi are either exotic or indigenous. Cattle are kept for the following purposes.

- Dairy production
- Beef production

Breeds of dairy cattle

These are cattle that are kept for the production of milk. It is therefore more economical to keep them for milk than for beef. The common dairy breeds in Malawi are as follows.

- Jersey
- Guernsey
- Friesian
- Ayrshire
- Brown Swiss
- Fleckvieh.

1. Jersey

Jersey cattle originated from Jersey Island in the English Channel, off the coast of France. They are now found all over the world. Their colours vary from light brown to black. The muzzle is usually black with a light-coloured ring around it.

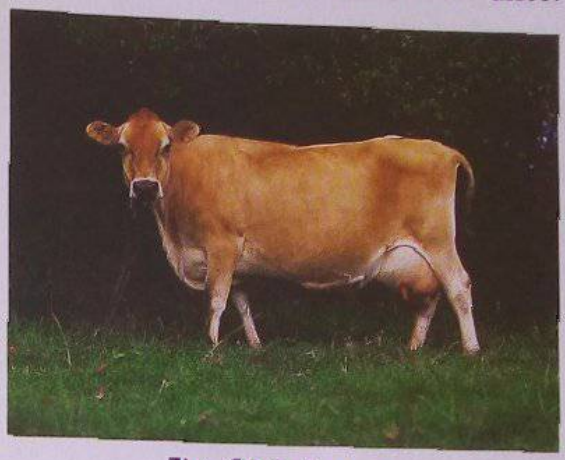

Fig. 13.1 Jersey

Jerseys are the smallest breed among the exotic dairy breeds of cattle. However, they have huge udders and good conformation. They produce about 2,700 kg of milk per lactation period which is 305 days. They produced little milk as compared to other exotic breeds. However, their milk has the highest butter-fat content of 5.3%.

Jersey breeds are hardy animals which withstand heat better than the other larger breeds of dairy. Their maintenance costs and food requirements are low. They do well on good or poor pastures.

The calves are small at birth but mature within 24 to 26 months. The bulls tend to be violent.

2. Guernsey

These cattle originated from Guernsey Island in the English Channel, off the coast of France. They are fairly big animals. Mature cows weigh about 410 kg. Their colour varies from yellowish brown to almost red, with white markings on the face, legs and switch. Their milk is golden yellow in colour and they can produce up to 3,600 kg of milk per lactation period. The milk has about 5% butter-fat content.

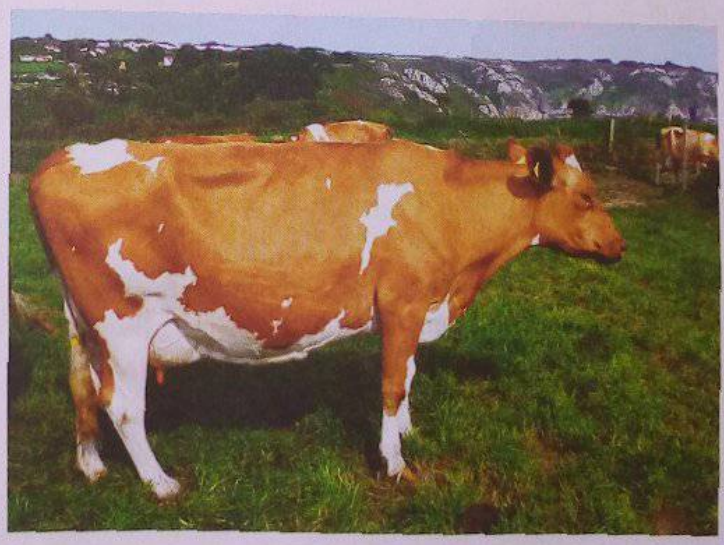

Fig. 13.2 Guernsey

Guernsey breeds are docile but are not as hardy as the Jersey. The calves are small at birth, weighing about 30 kg. After 30 months, the heifers are able to have their own offspring.

3. Friesian

Friesian cattle originated from Holland. In some countries, they are called Holstein. They are black and white in colour – the distribution of black and white colour varies from one cow to another. Friesians are the largest of the exotic dairy breeds of cattle. A mature cow weighs about 550 kg.

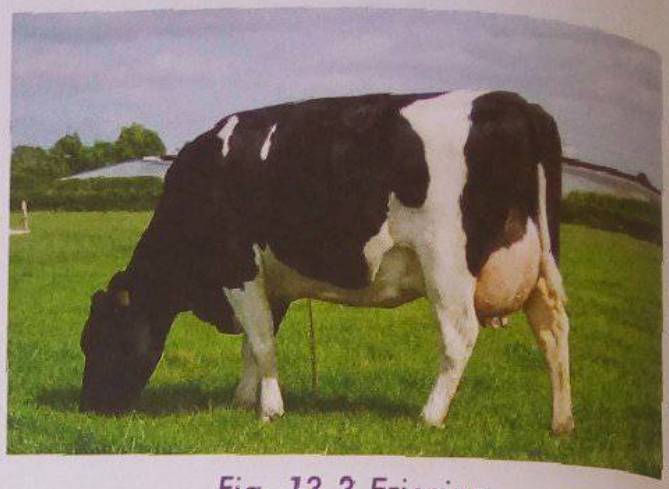

Fig. 13.3 Friesian

Friesians produce about 5,000 kg of milk per lactation period of 305 days. This amount of milk exceeds that of other exotic breeds. The milk is white in colour and has the lowest butter-fat content of about 3.5%. The cows are docile and are good grazers. They feed a lot because of their big bodies. They produce large calves weighing between 30 and 40 kg. The calves mature in about 30 months.

4. Ayrshire

This breed originated from Scotland. Its colour varies from red with white markings to white with red markings. It is a medium breed, with mature cows weighing about 450 kg.

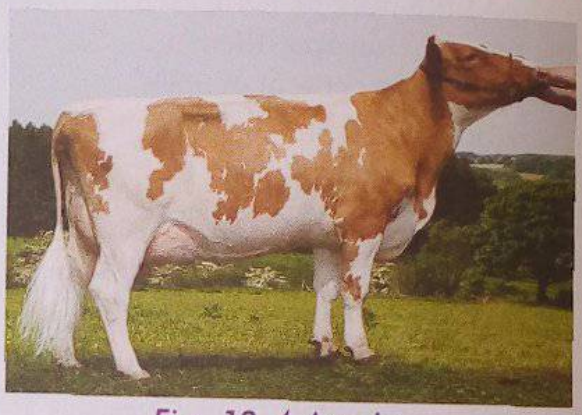

Fig. 13.4 Ayrshire

The Ayrshire is a good grazer. it is a hardy animal that can thrive on relatively poor pasture. It has an average milk production of 4,000 kg per lactation period with a butter-fat content of about 4%.

On average, their calves weigh between 30 and 35 kg at birth. Heifers may calve for the first time at 30 months of age.

5. Brown Swiss

This is a large breed of dairy cattle that has large bones. A few of them are kept in Malawi. The breed originated in Switzerland. It is mainly brown in colour, with some variations ranging from light brown to almost black. They have a lifetime milk production capacity of about 20,000 – 25,000 kg which is higher or equal to that of all the other dairy breeds put together.

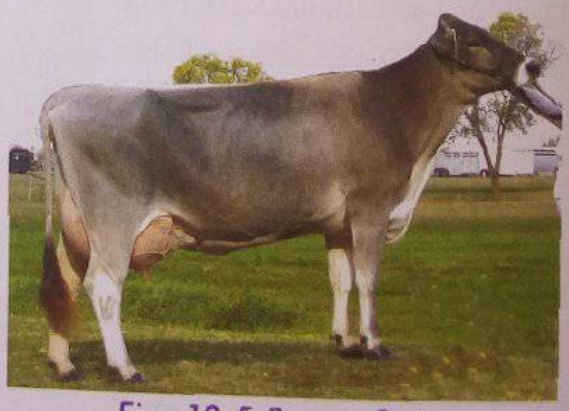

Fig. 13.5 Brown Swiss

6. Fleckvieh

Fleckvieh breed originated from South of Germany. It is very resistant to diseases. Ticks and tsetse flies cannot penetrate the thick skin of the breeds. The cows are also resistant to mastitis, a common disease that attacks dairy cattle. This is because their cell count is lower than that in other cattle. This means that the bacteria that cause mastitis have fewer places to hide. The milk yield is higher 7,000 kg with a butter fat content of 4.13%.

The animals do well on grazing pasture as well as under zero-grazing units. Apart from its high milk yield, the bull calves grow very fat and reach about 500 kg within six months after which they sold.

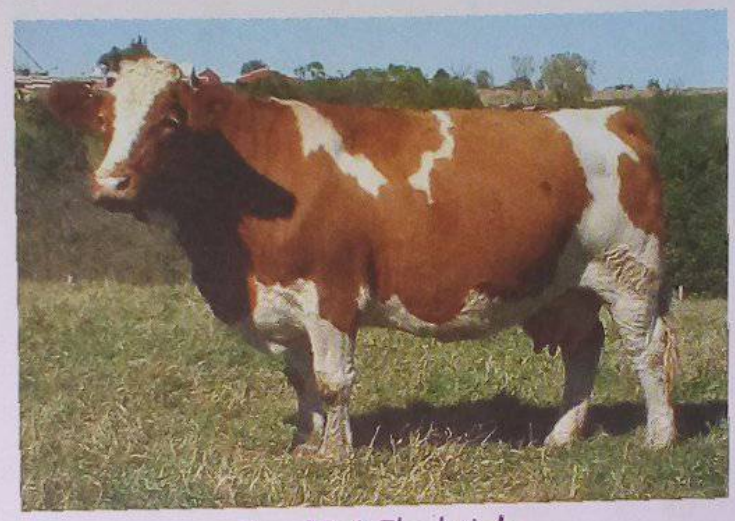

Fig. 13.6 Fleckvieh

General characteristics of dairy cattle

1. Their bodies are wedge or triangular-shaped. They have long, lean necks and a wide body capacity. Their wedge-shaped appearance is visible from the side as well as from the top.
2. They have a large body capacity—long, deep and wide— and thus consume a lot of food. Their ribs are well-spread.
3. Dairy cattle have large udders which have protruding mammary veins.
4. They have wide and well-set hind quarters which give room for the large udders.
5. They have thin bodies which carry little flesh as compared to beef cattle.
6. Most dairy cattle are docile and have a mild temperament.

Breeds of beef cattle

Beef cattle are mainly kept for the production of beef. Beef cattle are blocky or rectangular in shape and are well fleshed. The common beef breeds in Malawi are as follows.

- Hereford
- Aberdeen Angus
- Charolais
- Galloway
- Santa Gertrudis
- Shorthorn
- Boran

1. Hereford

This breed originated from England in Hereford country. It is red in colour except for its face, breast and underline which are white.

The animal is low-set and muscular and, compact and broad. It is a good converter of feed into meat. A mature bull weighs 1,000 kg and the cow weighs 850 kg. There are horned as well as polled breeds of Herefords.

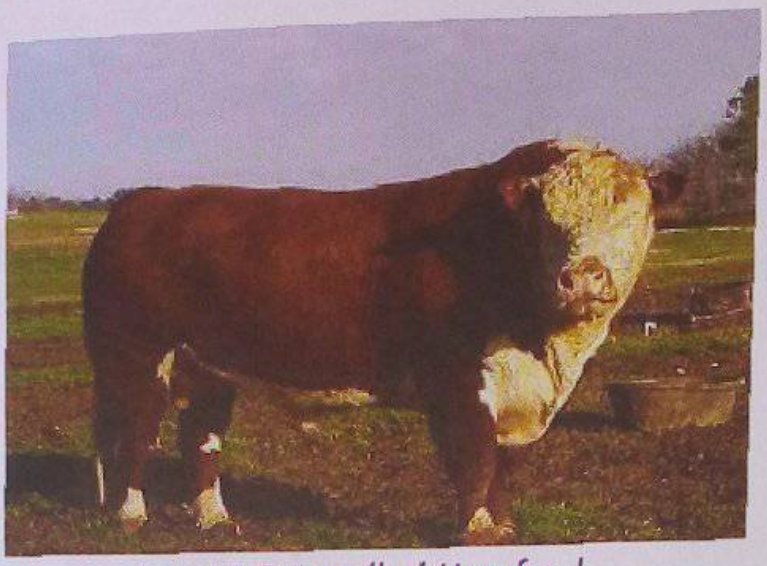

Fig. 13.7 A polled Hereford

2. Aberdeen Angus

This breed originated from northern Scotland. It is uniformly black in colour. It has a smooth coat of hair. Compared to other breeds, it has the best beef characteristics. They are blocky, muscular, low-set, compact and cylindrical in shape. On average, a mature cow weighs 720 kg while a bull weighs 900 kg.

These cattle are polled in nature. They are fairly resistant to certain eye diseases. The calves are small at birth but grow fast and catch up with the calves of larger breeds at the time of weaning.

Fig. 13.8 Aberdeen Angus

3. Charolais

Charolais originated from France. The breed is white or creamy white in colour. It is the largest of all the exotic beef breeds. A mature bull weighs up to 1,200 kg and a cow weighs up to 1,000 kg.

Charolais have a compact body and are known for their double-muscle quality in the hind quarters. The calves grow fast and mature early. The breed is ideal for crossbreeding.

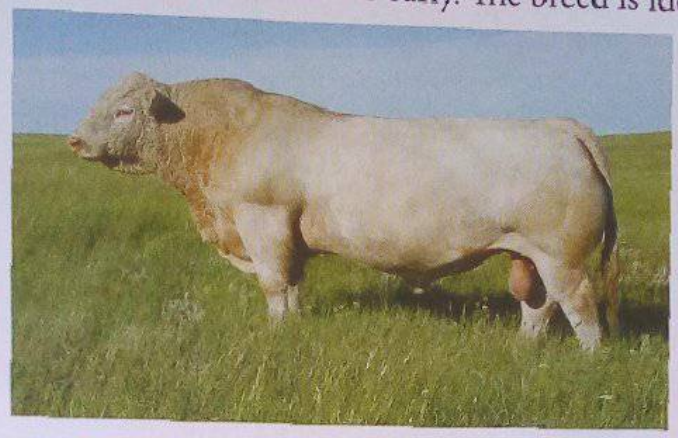

Fig. 13.9 Charolais

4. Galloway

The Galloway originated from Scotland. It is black in colour and has long curly hair which makes it resistant to cold weather.

This is the smallest of exotic breeds of beef. The animal is very hardy. It is polled, has short legs and a blocky compact body.

Fig. 13.10 Galloway

5. Santa Gertrudis

This is an American breed, newly-introduced in Africa. It was developed by cross-breeding Brahman beef bulls with beef Shorthorn cows. They are large animals, with a mature cow weighing around 800 kg and a bull weighing 1,000 kg.

The cattle are cherry-red in colour. They have loose hides that fold. They can tolerate heat and poor pasture conditions.

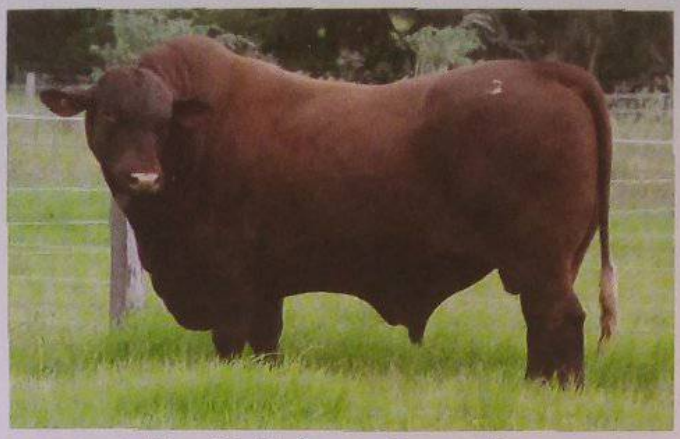

Fig. 13.11 Santa Gertrudis

6. Shorthorn

The Shorthorns originated from England. Their colour ranges from red to white while others have combinations of the two colours. They are large, rectangular and compact in appearance.

Some Shorthorn cattle are polled, while others are horned. A mature cow weighs about 850 kg while a bull weighs about 1,000 kg.

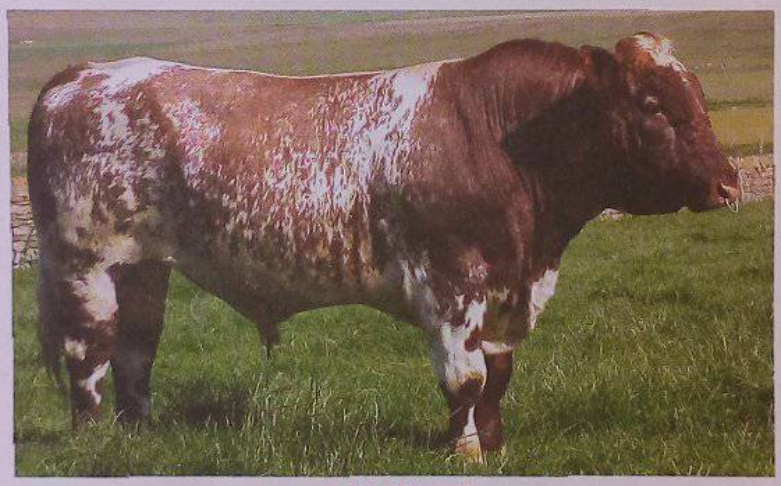

Fig. 13.12 Shorthorn

7. Boran

Boran cattle originated from Somalia and Ethiopia. They are the indigenous breeds of cattle in Africa. They are hardy and adaptable to harsh environmental conditions such as high temperatures and poor pastures and still produce good quality beef. The colours vary a lot but white, grey and red breeds are common.

The hump and the dewlap of a Boran are large. The animals have deep, compact and wide bodies. They have long legs and wide, drooping rumps.

A mature bull weighs up to 650 kg and a cow weighs up to 450 kg. Boran cattle are very hardy animals and can walk long distances in search of pasture and water. They are more

resistant to tropical diseases mthan the exotic breeds. They grow slowly and mature late. Heifers calve for the first time at 30 months of age. This is a good breed for upgrading the small East African Zebu cattle.

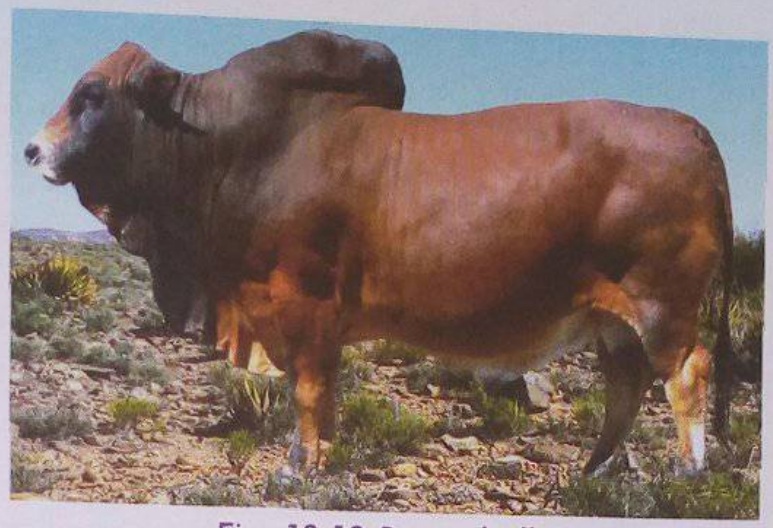

Fig. 13.13 Boran bull

General characteristics of beef cattle

1. Beef cattle have deep bodies with short legs that are well placed apart.
2. They are blocky in shape and have relatively heavy hindquarters. Their bodies are well fleshed.
3. They have strong and well developed muzzles to withstand rough pastures.
4. The top and lower lines of their bodies are more or less straight with the brisket protruding forward.
5. The hips and loins are well fleshed.
6. Beef animals grow fast and mature early.
7. They are strong and robust this enables them to cope well in a harsh environment.

Activity 13.1 Classifying breeds of cattle

(a) Under the guidance of your teacher, visit different cattle farms to observe different breeds of cattle. Classify the breeds of cattle identified into beef and dairy breeds.
(b) Record the characteristics of each breed identified in your notebooks.
(c) Discuss your findings in class.

Management practices for beef production

In beef production, young animals are reared and fattened for slaughter. They are sold in open local livestock markets or to slaughter houses.

Beef cattle should breed regularly to give a farmer one calf each year. Beef cattle management therefore puts emphasis on breeding of cows and rearing of young stock for sale or to replace the old ones.

Selection of cattle for breeding

Cows with good beef conformation and characteristics are selected for breeding. Heifers selected for breeding should weigh 250 – 260 kg. Bulls selected for breeding should be healthy and vigorous and should be 18 months of age or older. Cows take nine months to calve. A farmer should plan when to breed for the cows to calve when there is plenty of pasture. Breeding takes place in the pastures or ranches by mating the bulls and cows naturally.

When cows are about to calve, that is the last 50 days; they should be fed on good quality pasture so that they put on enough body weight in preparation for calving.

Rearing young animals

Allow the calves to stay with their mothers to breastfeed. Within the next two months, calves should be dehorned. Male calves which are selected for breeding are castrated. The calves should also be vaccinated against common diseases that attack livestock in the area.

At the age of two months, the calves should be placed on good pasture. This is because milk alone is not enough for the calves at this age. The calves are then weaned at 6 – 8 months of age. The best method of weaning is to separate the calves from their mothers.

Drenching should be done regularly to control worms. At 18 months of age, beef heifers and bulls should be selected for fattening.

Stocking rate

The stocking rate of beef cattle is determined by the amount of grass or pasture available during the driest periods of the year. Dividing the pasture into paddocks is very important for controlled grazing. When the grazing field is divided into paddocks, there should be access to clean water for the animals to drink.

Fig. 13.14 Water provided for cattle in a paddock

Culling

For maximum efficiency in production, culling should be carried out to remove unproductive bulls which are sold.

Factors to consider when culling include:

- Poor breeders which are barren.
- Cows that produce weak or small calves.
- Old cows past 10 years.
- Cows with poor maternal instinct.
- Parents of slow grazing calves.

Feeding beef cattle

Feeding beef cattle on grass is the most important activity in beef production. Good feeding determines the time taken for cattle to reach maturity. Care should be taken to prevent overstocking and overgrazing.

During the dry season, beef cattle should be given supplementary feeds to maintain good body weight. When drought is prolonged, animals should be selected. Those not suitable for breeding should be sold before they lose weight. Less or poor quality of grass slows down the growth rate of beef animals.

Good grass management principles such as rotational grazing are very important for a good herd. Feeds like hay and silage should be stored in large quantities to feed beef cattle during dry seasons.

Management practices for dairy production

The primary objective of keeping dairy cattle is to produce milk. A dairy farmer should therefore manage the cattle well to get high milk yields. The following management practices should be carried out effectively.

Selection of breeding stock

A dairy farmer should choose the right breed of dairy cattle among the breeds available. The breeds should withstand the climatic conditions of the area. Breeds that are adapted to local environmental conditions perform well under those conditions.

Once the farmer has chosen a particular breed (breeds), subsequent breeding will be aimed at improving the performance by further selection. Ideal dairy characteristics and performance of the cows are considered during the period.

Breeding

When a dairy herd has been established, a farmer should ensure that he/she breeds them regularly to be able to get at least one calf per year. A farmer should identify signs of heat in cows to breed them at the correct time. Breeding is done naturally or by artificial insemination.

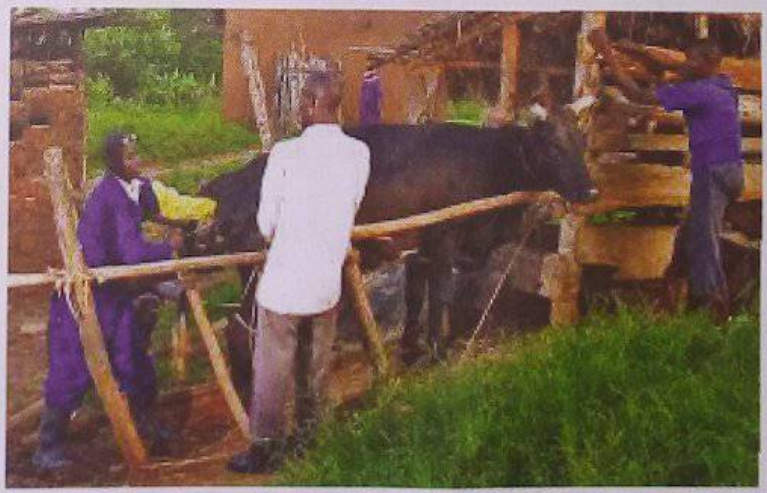

Fig. 13.15 A cow being artificially inseminated

Heifers should be bred at an average age of 18 months. It is important to note that heifers that are served early—before they are physically mature—may have calving difficulty and production is low. They remain stunted in growth. The weight of an animal at the time of service is also important. Heavy breeds should attain 280 – 320 kg while light breeds should be 250 – 270 kg at the time of service.

Management during gestation

The gestation period of cattle is 280 days. During this period, a lactating cow should be fed according to its level of production. Normally, cows are fed on grass. They are given concentrate supplements to increase milk yields. Heifers, on the other hand, should be fed well because they are still growing.

Milking the cow

Milking should start soon after the cow calves. Milking is the removal of milk from the udder of a ruminant animal after it has calved. Milking is done either by hand or using a milking machine. Milking of cows manually, using the hand, is popular in Malawi since most farmers practice dairy production on small scale.

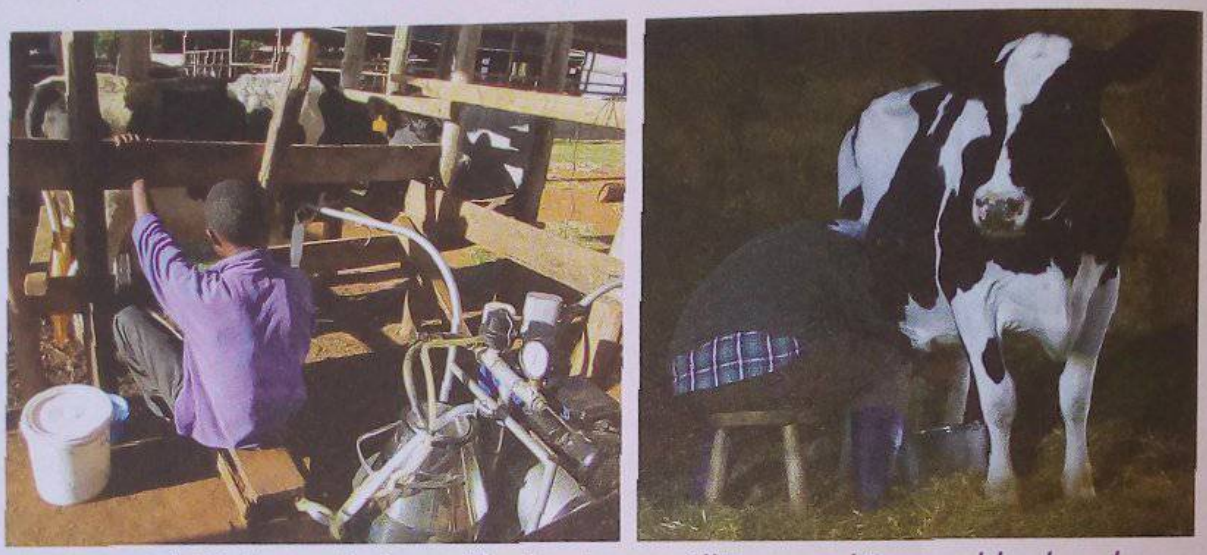

Fig. 13.16 A cow being milked using a milking machine and by hand

Milk produced should be clean and fit for human consumption. After seven months of pregnancy, the cow should be dried off. Drying off a cow is a management technique of gradually stopping to milk a lactating cow, especially when milk production is low.

Activity 13.2 Discussing management practices for beef and dairy production

In groups of five, discuss the management practices undertaken by livestock farmers in beef and dairy production. Record your findings in your notebooks.

Suitable houses for cattle

In Malawi, cattle are housed to protect them from extreme climatic conditions such as rain, heat and direct light from the sun. Houses also protect them from predators and thieves. Calves should be kept in individual pens measuring at least 1 m × 1.5 m. Suitable houses for cattle should be kept clean to reduce the spread of diseases.

There are different types of houses for cattle – the loose housing system and cubicle system. In the loose housing system, cattle are kept in a big barn which is filled with straw. This type of housing is economical to the farmer. In the cubicle system, cattle are kept in cubes. This system is good as it is easy to clean and maintain. It reduces the spread of diseases in cattle. However, the limitation is that this type of house is expensive to set up.

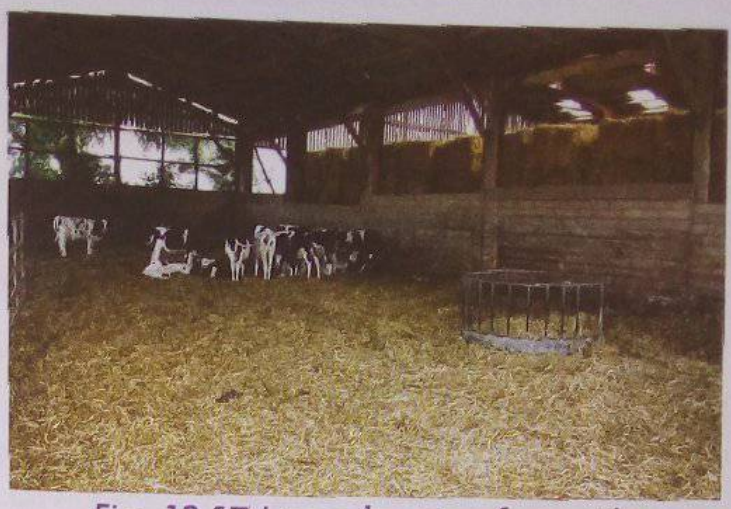

Fig. 13.17 Loose housing for cattle

Characteristics of a good cattle house

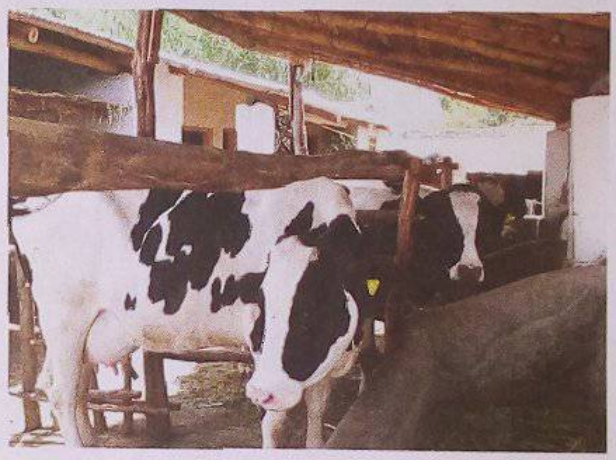

Fig. 13.18 A good house for cattle

1. In warmer areas, pens can be constructed outside on pastures. In cold areas, the cattle houses should be permanent structures that provide warmth. They should be free from draughts.
2. It should have a cemented floor that is sloping to allow proper drainage. The floor can also be made of wood with spaces to allow drainage of urine.
3. The house should have good ventilation with windows on the windward side of the house. Open space fitted with wire mesh should be left on the walls facing each other. The walls should be opposite to the oncoming wind.
4. The roof can be made of any local material provided it is waterproof. The walls can also be constructed using any available materials.
5. Where a pen does not have a raised floor, dry bedding materials should be placed on the floor. The beddings should be replaced frequently.
6. In case a farmer is practising zero grazing, feeding and water troughs should be made where the cattle can feed and drink water easily.

Activity 13.3 Observing cattle houses

(a) Visit nearby cattle farms around your school under the guidance of your teacher.
(b) Observe the cattle houses on the farms and list the characteristics of a good cattle house.
(c) Choose an appropriate house for cattle in your local area.

Constructing an appropriate house for cattle

Houses for cattle can be constructed using locally available materials. The materials required for constructing a cattle house include:

- timber, pieces of wood or plywood
- poles
- straw or grass
- concrete
- nails
- oil
- hammer.

Procedure for constructing a cattle house

A loose housing is appropriate for most farmers in Malawi since it is less expensive and easy to construct. A three-sided barn is always appropriate as long as it faces away from the direction of prevailing winds.

1. Choose a site that is a bit elevated and dig four holes to form a rectangular shape. The size of the house will depend on the number of cattle to be kept. The space allocated for each adult animal should be 8 m^2.
2. Apply oil on the poles to prevent attack from termites. Put strong poles into the holes that you have dug and cover with soil. You can use concrete if available.
3. Make the roof using grass or iron sheets. Ensure that this done well to prevent leakages.
4. Make the walls by nailing the pieces of wood or plywood on the poles using the nails and hammer.
5. Cover the sides well and leave one side open as it will be used as the entrance and exit into the shed.
6. Make the floor using concrete and put up a good drainage system. Pieces of timber can also be used in making the floor. They should be placed slightly above the ground to leave some space below the shed. The floor should be slatted to ensure appropriate drainage and easy cleaning.

Fig. 13.19 A slatted wooden floor

7. Leave enough spaces for ventilation.
8. Spread straw in a section of the house to provide bedding for the cattle.

Activity 13.4 Constructing a cattle house

(a) With the help of your teacher, collect appropriate materials for constructing a house for cattle. Your teacher will then demonstrate to you how to construct a cattle house.

(b) Construct a house for cattle in your school farm using locally available materials. Put on appropriate clothing during the pratical.

Suitable feeds for cattle

Roughages are the main feed for cattle. Roughages include bulky feeds such as Napier grass, maize stoves, banana stems, sweet potato vines, hay and silage. Roughages are grown on the farm by farmers and can also be acquired from plant leftovers. They are the cheapest feeds for cattle and are locally available as compared to concentrates which have to be bought.

Fig. 13.20 Dairy cattle feeding on Napier grass

Good quality roughage is essential in milk production. Napier grass can be cut when it is 60 – 90 cm tall. It is a very nutritious type of roughage for dairy cows. However, when it overgrows, its quality reduces.

Roughages such as maize stoves, banana stems, Napier grass and silage have very little crude proteins. Animals being fed on such low protein roughages must also be fed on protein rich feeds such as desmodium, sweet potato vines, and fodder tree leaves like bananas and lucerne.

Concentrates are products such as dairy meal, brewer's waste, rice bran and meal cakes. Dairy meal or dairy cubes are more balanced concentrates for milk production.

Concentrates rich in energy are maize bran and maize germ. Concentrates rich in proteins include copra cake, cotton cake, sesame cake and brewer's waste.

Farmers are advised to buy concentrates from re-known companies to avoid getting those poor quality.

The cattle should also be given mineral blocks to lick. This will provide them with essential minerals and vitamins required by the body for growth.

Activity 13.5 Discussing suitable feeds for livestock

(a) Visit nearby livestock units and find out from the farmer the feeds that are suitable for cattle.

(b) Observe feed samples available. List the feeds in your notebooks.

(c) Discuss the feeds that are suitable for cattle from the information you have acquired from the farmers.

Diseases that affect cattle

Diseases attack cattle and distort the normal functioning of the body. Each disease brings out different signs and symptoms in infected cattle. Cattle, like other animals, contract diseases through a number of routes or areas in the body such as the nose, mouth, skin, eyes and ears. The common diseases of cattle are:

- Foot and mouth disease
- Anaplasmosis
- Red water
- East coast fever
- Trypanosomiasis
- Foot rot
- Pneumonia
- Black quarter
- Brucellosis
- Anthrax

Foot and mouth disease

This is a severe disease that is highly infectious in cattle. It is caused by viruses. The disease is highly contagious and spreads quickly if it is not controlled.

Signs and symptoms

Infected cattle usually exhibit the following signs.

1. They have a high fever and look dull.
2. Loss of appetite in cattle.
3. Profuse and continuous salivation. The saliva flows from the mouth and is very sticky.
4. The animals keep swaying due to tenderness and weakness in the legs. In some cases, cattle may be lame.
5. The animals become emaciated and produce less milk.
6. There are blisters and wounds on the tongue, mouth, gums, toes, burst, teats and nose of the infected cattle.

Fig. 13.21 A blister on the foot of a cow

Control measures

1. Quarantine infected animals to prevent the disease from spreading to the healthy animals.
2. Vaccinate the animals against the disease regularly. This should be done after every six months.
3. Slaughter and burn carcasses of infected animals.

Anaplasmosis

This is a vector-borne disease that is very infectious. It is known as the disease of blood. It mostly affects animals in the warm tropical areas. It is commonly transmitted by ticks. On the other hand, it can be transmitted through livestock equipment such as contaminated needles, dehorning equipment and castration tools.

Signs and symptoms

1. Cattle have high fever. They also suffer from constipation which leads to loss of appetite.
2. Animals suffer from anaemia and the mucous membranes become yellowish.
3. A drastic loss in weight in the infected cattle.
4. Most of the cattle have uncoordinated movement.
5. In extreme cases, the cattle usually die.

Control measures

1. Carcasses of dead animals should be disposed of well through burning.
2. Control ticks and ensure that cattle are kept in a clean environment.
3. Vaccinations can be used to control the spread of the disease.

Red water

This disease is known as Bovine babesiosis or tick fever. It is caused by bacteria and spread by ticks.

Signs and symptoms

1. Cattle have high fever.
2. Urine excreted is dark or red in colour.
3. They have uncoordinated movement.
4. Animals have swollen lymph glands.

Control measures

1. Control ticks through dipping and spraying with appropriate chemicals.
2. The cattle should be vaccinated against the disease.

East coast fever

This is a protozoan disease that is transmitted by ticks. The ticks normally stick behind the ears of cattle.

Signs and symptoms

1. Infected cattle experience difficulty in breathing.
2. The eyes and gums discolour and become white.
3. Cattle have enlarged lymph nodes in the areas where the ticks are.
4. Cattle die since their blood capillaries are blocked.
5. Cattle diarrhoea and the stool has blood stains.

Control measures

1. The ticks should be controlled through spraying and dipping cattle.
2. Carcasses of dead animals should be disposed of well.

Trypanosomiasis

This disease is caused by protozoa and is transmitted by tsetse flies. The disease is also known as Nagana.

Signs and symptoms

1. Fever in infected animals.
2. Dullness and loss of appetite.
3. Cattle become anaemic.
4. Animals may be seen licking soil and have swollen lymph nodes.
5. Running eyes or they may become totally blind.

Control measures

1. Drugs can be administered to the cattle to treat the disease.
2. Bushes should be cleared to control tsetse flies or they can be sprayed using insecticides.

Fig. 13.22 A cow suffering from trypanosomiasis

Foot rot

This disease occurs mostly in adult cattle. It is rampant during the wet season. Bacteria that cause the disease enter the foot of cattle through wounds on the foot. Cow dung and manure cause the skin on the foot to become soft. It is broken into easily by stones or other objects making the animals susceptible to the disease.

Fig. 13.23 Infected foot of a cow

Signs and symptoms

1. The hooves become swollen.
2. Lameness may occur in one foot as only one foot is usually affected.
3. A moderate rise in temperature in the animals.
4. Puss may form in the affected area.

Control measures

1. Infected cattle should be treated using antibiotics.
2. Rotten parts of the hooves should be trimmed and removed. The animal should also be isolated.
3. Cattle should be provided with a foot bath copper sulphate solution to prevent the disease.
4. Routine trimming should be done on the cattle.

Pneumonia

This is a disease of the lungs that attacks calves mostly. It occurs due to poor housing. It is caused by different viruses and bacteria. It is referred to as Bovine respiratory disease.

Signs and symptoms

1. There is decreased growth rate in calves.
2. Calves may have either very high or very low body temperatures.
3. Difficulty in breathing is experienced. The calves may have coughs too.
4. Nasal discharge and congestion in the chest.
5. There is less movement from the animal. It is usually dull and sleepy.
6. Loss of appetite.

Control measures

1. The farmer should provide each calf with enough space to avoid overcrowding.
2. Good housing should be provided to reduce respiratory diseases. Therefore, the house should be free from draught and be well ventilated.
3. Proper management practices should be put in place.
4. Calves should be vaccinated against the disease.
5. Infected calves should be isolated from the healthy ones to reduce the spread of the disease.

Black quarter

This is an infectious disease caused by bacteria. It is also referred to as blackleg. It is difficult to treat the disease because it is severe. It causes inflammation of the skeletal muscles of cattle. Cattle get this disease by feeding on infected pasture. The bacteria grow and produce large amounts of gases in the muscles of the cattle.

Signs and symptoms

1. The animal develops a high fever and shivers.
2. Loss of appetite and dullness.
3. The limb swells and when pressed, it produces a crackling sound.
4. Lameness may develop in the affected leg.
5. The skin over the swelling is not sensitive to touch.

Control measures

1. Vaccinate cattle against the disease regularly.
2. If detected early, the animals should be treated with antibiotics.
3. The carcasses of infected animals should be disposed by burying them deep into the ground.

Brucellosis

This disease is also known as contagious abortion. It is caused by a bacterium known as Brucella abortus. It causes abortion or premature calving in infected cattle. This usually occurs between the fifth and eighth month of pregnancy. It is normally spread from vaginal discharges of an infected cow or from a foetus that has been aborted. Infected bulls can infect cows when the cows are serviced using the infected semen.

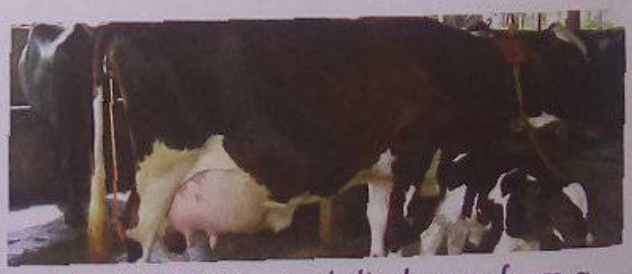

Fig. 13.24 Vaginal discharge from a cow suffering from Brucellosis

Signs and symptoms

1. The vulva becomes swollen and inflamed. There is a slight discharge from the vulva.
2. An increase in the quantity of blood-stained discharge from the vulva.
3. A yellowish brown discharge can be seen from the vagina after abortion or normal delivery.

Control measures

1. Vaccination of cattle and calves.
2. Quarantine infected cattle to prevent the spread of the disease.
3. The uterus can be washed with antiseptic solution.

Anthrax

This is a highly infectious disease that attacks both cattle and human beings. It is very fatal. It is caused by a bacterium known as Bacillus anthracis.

Signs and symptoms

1. Sudden death occurs in cattle.
2. The cattle become weak and have high fever.
3. The animals become excited at first and then become depressed.
4. There is difficulty in breathing.
5. Uncoordinated movement is observed in animals.
6. Blood is discharged from the natural body openings such as the nose and ears.
7. Dead cattle decompose very quickly.

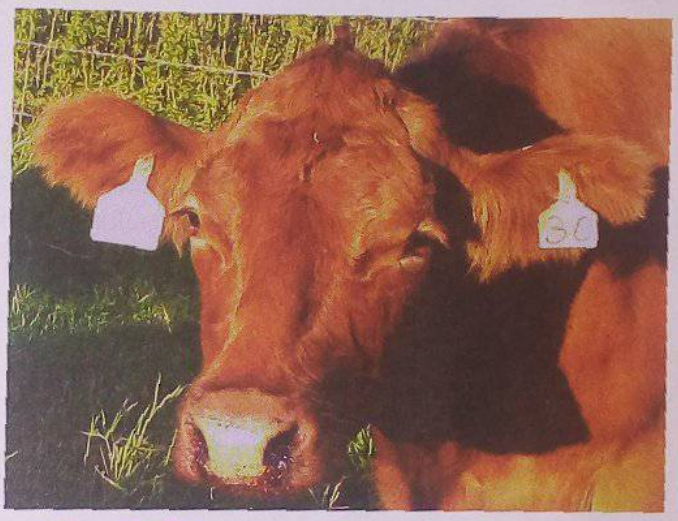

Fig. 13.25 A cow infected with anthrax

Control measures

1. Treat the animals early with antibiotics.
2. Vaccinate cattle against the disease.
3. Dispose the carcasses of dead cattle through burying them deep into the ground.

Activity 13.6 Discussing signs of diseases of cattle

(a) Carry out research in the school library on the diseases of cattle.

(b) Outline the diseases of cattle in your notebooks and describe the signs and symptoms of each disease in pairs. Observe pictures of cattle infected by each of the diseases.

(c) Explain the control measures that should be taken in order to control the diseases of cattle.

(d) Visit a nearby cattle farm and observe a veterinary officer control diseases in cattle.

Parasites that attack cattle

Cattle parasites are grouped as external parasites (ectoparasites) and internal parasites (endoparasites). Ectoparasites stay outside the body of the cattle, sucking blood and causing irritation. They include fleas, lice, ticks and tsetse flies. Endoparasites live inside the body of cattle. They include roundworms, flukes and tapeworms. Parasites lower production in cattle.

Ectoparasites

Fleas

Fleas are wingless insects with flat bodies. They have strong legs with which they leap to great distances. Their bodies are covered with bristles which point backwards and enable them to hold onto the host and move forward. Fleas suck blood from cattle and cause itching.

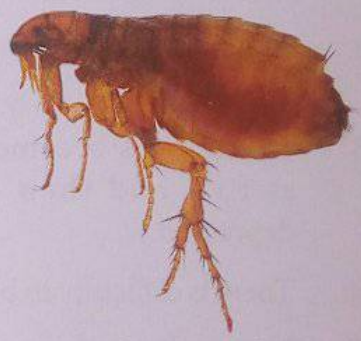

Fig. 13.26 A flea

Control measures

1. To control fleas, the cattle should be sprayed with insecticides. Infected beddings should be removed. breeding places should be sprayed, giving attention to cracks and hidden places. The cattle can also be dusted using dusting powders.
2. Fleas can be treated by applying a mixture of kerosene and lard. The fleas will fall on the floor. The floor should then be cleaned out and fleas burnt.

Lice

Lice are small wingless, biting and blood-sucking parasites that live on the skin of cattle. Sucking lice have a narrow head with mouth parts adapted for penetration into the skin when sucking blood.

They cause irritation and the cattle scratch, bite and rub their skin a lot. They lead to reduced weight gain in cattle. They also cause damage on the skin of cattle.

Control measures

Control involves spraying cattle with suitable acaricides at least twice. The first application is to kill the lice on the body. The second application is to kill the newly hatched larvae.

Ticks

Ticks feed on blood obtained from the host animal. Ticks are a major problem in cattle. They transmit dangerous diseases like East Coast Fever, black quarter, anaplasmosis and red water.

Control measures

The cattle should be dipped regularly to kill the ticks.

Tsetse flies

The tsetse fly transmits a disease known as trypanosomiasis or sleeping sickness. It leads to stunted growth and loss in yields. Some tsetse flies also transmit mastitis in animals.

Fig. 13.27 Tsetse fly

Control measures

1. Bushes should be cleared to control tsetse flies.
2. Alternatively, such bushes should be sprayed with insecticides to kill the flies or keep them away.

Endoparasites

Roundworms

Their bodies are long, cylindrical and have smooth bodies. They cause stunted growth in animals, reduction in yields, diarrhoea, constipation and anaemia.

Control measures

1. Roundworms can be controlled through grazing livestock on well drained pastures.
2. They can also be controlled through practising rotational grazing, isolating and treating animals that are suspected to be infected with roundworms.

Flukes

They are shorter than tapeworms and their bodies are not segmented. Different fluke species live in different areas in the body of an animal. They cause severe diseases in cattle in the areas that are affected. They often lead to the death of animals. For example, the liver fluke is found on the liver whereas rumen flukes are found in the rumen.

Control measures

1. Flukes are controlled through controlled grazing and keeping cattle away from stagnant water.
2. Eradicate mud snails by spraying stagnant water with copper sulphate.

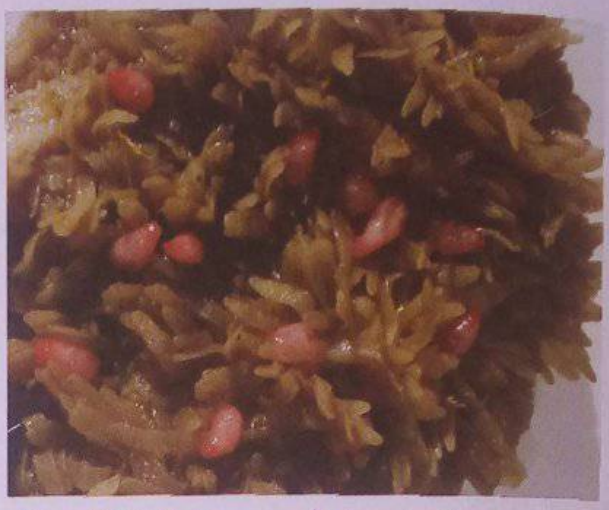

Fig. 13.28 Rumen flukes in the rumen of a cow

Tapeworms

Tapeworms affect all domestic animals. They are found in the intestines. They attach themselves with their hooks to the wall of the small intestines where they develop. They obtain nutrients directly from the food eaten by an animal.

Control measures

1. Tapeworms are controlled by ensuring that all beef is properly cooked before eating.
2. Human faeces should be deposited in appropriate places.
3. Affected animals can be treated with copper sulphate after every 6 weeks.

Activity 13.7 Observing how parasites are controlled in cattle

(a) Your teacher will organise for you a visit to a cattle farm on a day when parasites are being controlled. Observe animals that have been affected by parasites and record the signs of different parasite infestations in the cattle.

(b) Observe the farmer as he or she controls the parasites in the cattle.

Practical activities

1. As a class, visit a few nearby cattle farms and find out the following information.
   (a) The types of cattle commonly kept in farms around your local area.
   (b) The produce from cattle.
   (c) Observe the characteristics of beef and dairy cattle.
   (d) List down the cattle breeds on the farms.
2. Visit some of the farmers you visited in (1) above and carry out the following activities in their farms.
   (a) Milking cows
   (b) Feeding of mature cattle
   (c) Controlling parasites in cattle.

Summary

- Cattle are classified in two major groups—indigenous cattle (local) and exotic cattle. They can also be classified based on the purpose they are kept for. There are dairy, beef or dual purpose breeds.
- There are four main dairy breeds: Friesian (Holstein), Aryshire, Guernsey and Jersey.
- The Jersey animal is known to have the highest butter fat content of 5.0 – 5.3%.
- The Friesian is the largest dairy breed, producing the highest amount of milk.
- The Aryshire is a good grazer and hardy.
- Other breeds of dairy cattle include the Brown Swiss and Fleckvieh cattle.
- Good dairy animals must have a triangular/wedge shaped body, large womb, large firm udder, wide and well set hind quarters and have less flesh on the body.
- The beef breeds of cattle include Hereford, Aberdeen Angus, Charolais, Galloway, Santa Gertrudis, Shorthorn and Boran.
- Beef animals should have blocky, deep well-fleshed bodies with short legs that are well set, strong and well-developed muzzle, hips and loins that are well fleshed.
- Dairy management practices include proper selection and breeding.
- The houses of cattle should be spacious, clean, well drained and free from draughts and warm.
- Feeding is an important management practice especially in dairy cattle: the animals should be fed on high quality concentrates and roughages, and given plenty of water.
- Livestock should be protected from both external parasites such as fleas, mites, ticks and tsetse flies and internal parasites such as roundworms, tapeworms and liver flukes.
- The most common diseases that attack cattle are East Coast Fever, anaplasmosis and trypanosomiasis.
- Bacterial diseases include foot rot, pneumonia, black quarter/black leg, brucellosis and anthrax.

Revision questions 13

1. What are the general characteristics of the following types of cattle?
   (a) Dairy breeds (b) Beef breeds
2. List the beef breeds of cattle in Malawi.
3. What immediate steps should a farmer take as soon as he or she notices the symptoms of pneumonia in a dairy calf?
4. Describe the management practices that should be carried out by dairy and beef cattle farmers.
5. (a) List five diseases of cattle.
   (b) How would a farmer control the following cattle diseases: