



**'O' LEVEL**

**AGRICULTURE  
STUDY PACK**

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**S. Madzingira**

# CHAPTER 1

## INTRODUCTION TO AGRICULTURE

### **Chapter Objectives**

After completing a study of the chapter, the student should be able to:

- Define the following terms:
- Season length.
- Season quality.
- Rainfall intensity.
- Describe with the aid of a diagram how rainfall is formed.
- Distinguish leasehold from freehold as title land-ownership types.
- Give four (4) advantages of crop rotation.

### **General overview**

#### **What is Agriculture?**

As the first thing, it is important to define what Agriculture is all about. Agriculture is the growing of crops, field crops and ornamental trees. It is also about keeping of live stock, that is, cattle, sheep, goats, pigs, poultry, crocodiles, fish and rabbits. Agriculture is vital for any nation or country. This is so because each nation or its government has to feed its citizens first and foremost. If the country has no food, then it becomes very difficult to rule the people. Therefore every nation has to strive to be self sufficient in food provisions. A hungry nation is a sick nation.

### **Importance**

The importance of Agriculture is based understood in terms of what it provides to humans and animal life. Here are some of the benefits from agriculture:

- a) It provides food.  
Agricultural food may be in the form of mealie meal, relish, milk, fruits etc. When individuals or groups engage in the practice of Agriculture, they can at least sustain their lives.
- b) Employment creation  
People in primary industries such as farming, can provide employment directly or indirectly to other sectors of the economy. Direct employment creation is made possible as individuals are being engaged in commercial farms, working for wages and salaries. Indirect employment occurs through labour being employed in companies such as ZFC, Windmill, National Foods, Olivine Industries etc, where products such as maize grain and groundnuts are processed into mealie-meal and cooking oil.
- c) Earning foreign currency to the country.  
The exportation of beef, milk, maize, pork, tobacco, cotton, flowers etc brings in the much needed foreign currency which is often in short supply. Foreign currency is vital for trade with other countries, buying of machinery from abroad and other equipment needed for maximum production in the local industries.
- d) Providing raw materials.  
The textile industries, beef, milling, leather etc, require products from agriculture for the large labour force to remain in employment.
- e) Improving living standards of people.  
When people are engaged in agriculture, they can improve their living standards. This is done through selling products from agriculture and getting money to run their family affairs. They buy better quality foods, build better houses and afford entertainment.
- f) As a means of saving.  
When people practice farming, a lot of money can be saved. This is so because one no longer buys, for example, such things like tomatoes, vegetables, chicken and eggs. Money saved per day may appear little, but as it accumulates over a week or a month, it becomes a substantial amount.
- g) Provides fuel.  
Sugar cane production provides kerosene or paraffin, and a type of petrol used in machines and domestic purposes. Biogas is derived from human and cattle waste. Jatrofa is used to produce petrol for use in cars. Trees are used as firewood especially in curing tobacco.

### **Branches of Agriculture**

Agriculture is divided into seven branches namely:

- (i) Crop husbandry.
- (ii) Animal Husbandry.
- (iii) Farm engineering/farm structures.
- iv) Wild life
- (v) Agriculture economics
- vii) Agronomy

- vi) Horticulture
- a) **Crop Husbandry:-**  
Is a branch that deals or looks at the management or care given to growing of different crops. Crops (field crops; maize; groundnuts, wheat millet sorghum etc), also require protection against weeds and pests.
- b) **Animal Husbandry**  
- It is the rearing or keeping of farm animals: These include goats, sheep and poultry. This also includes vaccination; dosing, dehorning, castration etc.
- c) **Farm engineering**  
It is a branch that looks at the care and maintenance given to farm machinery, equipment and tools. Machinery; equipment and tools require a lot of money to buy, hence they need to be cared for and well maintained.
- d) **Wildlife**  
A branch that deals or looks at the care and conservation of wildlife i.e. forests, wild animals (rhinoceros, elephants giraffes etc) so as to avoid extinction of particular tree and animals species
- e) **Agriculture Economics:**  
It deals with the wise use of money as a resource in the business in order for business to be viable and profitable. It looks at aspects of recording income expenses incurred, and comparing these to arrive at profit margins generated on each enterprise
- f) **Agronomy:-** It is a branch that deals in the art and care of using the soil, so that it maintains its fertility, thus remaining productive for a long time.
- g) **Horticulture-**  
It is the growing of fruits, vegetables and ornamental plants.

### **Factors affecting Agriculture in Zimbabwe**

Agriculture in Zimbabwe is affected by several factors namely:

- i) Rainfall.
- ii) Temperature.
- iii) Wind.
- iv) Soil fertility.
- v) Soil type.
- vi) Political stability.
- vii) Capital.
- viii) Pest and diseases.

NB: Of all the above factors, rainfall, temperature; and soil type, seriously affect crop production which is very vital for human survival.

### **A Close look at each of the above factors**

- a) **Rainfall:** Rainfall is required for normal crop growth. Water is required by plants for all chemical activities in plants, and for maintaining higher pressure in cells.

Rainfall affects agriculture through its distribution and season length.

NB: Distribution refers to how much of the rainfall is spread throughout the seasons. For instance, if we say 600mm is required for normal growth of a maize crop during its five month period of growth, we would expect 120mm/month ( $600 \div 5$ ) for the maize crop.

By season length, we refer to the length of a season i.e from the onset of summer rains up to the period of tailing off rains, that is, the time of stopping e.g from beginning of November to end of March.

- b) **Temperature:-** This refers to amount or degree (extent) of hotness or coldness in a given body. Plants have an optimum temperature of ( $18^{\circ}$ - $30^{\circ}$ c) necessary for seed germination and plant growth. In Zimbabwe we usually experience good temperatures which are suitable for crop growth ( $18^{\circ}$ - $30^{\circ}$ c). However different crops favour different temperatures, for example sugar can requires high temperatures ( $30^{\circ}$ - $32^{\circ}$ c), hence it is grown in Triangle and Chiredzi which are hot areas. Contrary to this, tea, coffee and tubers require low to moderate temperatures, hence they are grown in the Eastern Highlands

- c) **Soil type**

In Zimbabwe, soils range from poor sands to sandy loamy and heavy clay soils. However crop products are not seriously affected by soils in Zimbabwe, but by rainfall and temperatures.

- d) **Capital**

It is money that is required to start or manage a business. This factor does not seriously affect farmers in Zimbabwe, especially peasants, because they grow crops for subsistence only.

- e) **Pests and Diseases**

This refers to ailments that affect plants. They are not a serious problem to most crops grown in Zimbabwe, although they have to be controlled when ever they threaten.

### **Rainfall, and its Effects**

(Excessive and little rainfall)

- a) Rainfall has a serious bearing on crop growth if it becomes excessive or too little. The impact can negatively affect yields causing an economic loss to the farmers, thus returns realized can be very low.

### **Effects of Excessive Rainfall**

- i) Fungal diseases are common in wet conditions that are very conducive to fungal infection. For example in crops e.g. early and light in tomatoes.
- ii) Soil erosion: Loss of top soil by running water (rainfall is in form of hailstorm or heavy down falls, these massive soil erosion will ensue (follow)

- iii) Leaching of plant nutrients:- Leaching is the washing away of plant food (nutrients) far below plant roots. This results in yellowing (chlorosis) in maize and stunted growth and poor yield.
- iv) Water Logging- the accumulation of water on a particular area or field. It results in poor aeration in soil resulting in death of microbes

**Effects of little rainfall:-** Little rainfall has a worse or devastating effect than too much rainfall. This is so because no running water finds its way to rivers and dams, hence no water for animals to drink and irrigation purposes. The following effects will be experienced if rainfall is inadequate.

- i) Temporary or permanent wilting of plant. This results in slow growth or permanent death to crops.
- ii) Low/ poor yields, for example, the shortage of rainfall at critical stages of maize growth e.g flowering results in drying of tassels and silk, hence no yield or low yields are obtained.

### **Effects of excessive temperature**

Optimum or particular trends are necessary for plant growth and reproduction processes. High temperature can result in excessive rate of transpiration, causing wilting and permanent death to plants. Very low temperature e.g., 5°C- 3°C can induce conditions favourable for frost-bite in tomato crops, resulting in damage to crop and poor yields.

### **Methods of reducing effects of excessively high temperatures**

Although excessive high temperature cannot be controlled by man, the following method can be used to reduce high temperature:

- i) **Frequent watering:**  
This means watering crops regularly for example, after 5-7 days you irrigate the crop depending on soil type.  
NB: Irrigate after 5 days in sand soils and 7 days in clay soils.
- ii) **Mulching**  
This is the application of vegetative matter, for example, grass on seed beds to reduce direct heat from the sun on the soil surface. Mulching acts as a blanket that prevents water loss from the upper soil surface layer.
- iii) **Shading transplants**  
This can be done on garden crops such as tomatoes, and cabbage transplants, which can be re-planted on prepared beds.
- iv) **Transplanting under cool conditions**  
This means transplanting of plants preferably late in the afternoon, around 3pm to 5pm.

### **Revision questions**

- 1) State and briefly explain 5 importance of Agriculture to the Zimbabwean economy.
- 2) List any four factors affecting Agriculture in Zimbabwe.
- 3) List the effects of too little rainfall on crop production.
- 4) Give any five branches of Agriculture

### **Rainfall**

It is the precipitation from clouds, in the form of rain, hailstorm and drizzle, formed by condensation of water vapour after rising up to great heights and cooling.

### **Season length**

It is the period extending from the first effective rainfall of the season up to the end of the rain season. Effective rainfalls are those rains which are able to effect or bring about germination of seeds. In other words season length is the period from the start of rains (November) to the end of rains (March)

### **Season quality**

This is a measure of the distribution of rainfall within the season. For example, if we receive 600mm of rainfall in a season, then if 120mm were received per month over 5 months we can then talk of a good season quality for this particular season.

### **Reliability of rainfall**

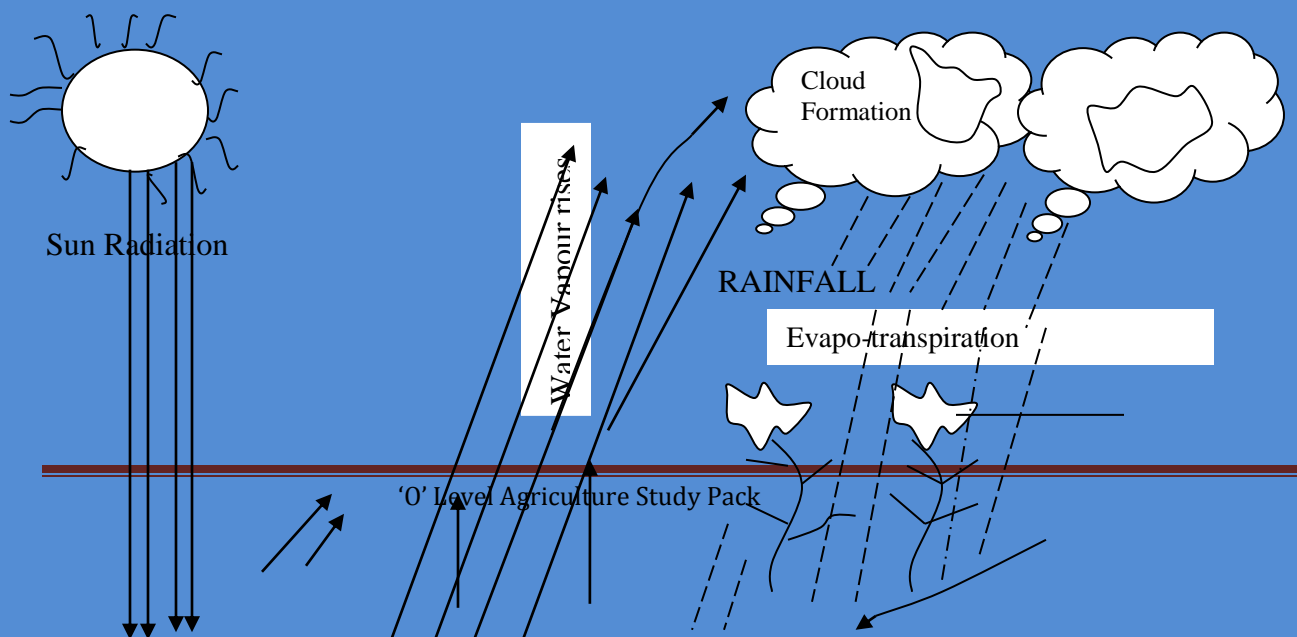
This refers to the regularity of the rainfall from year to year, which a farmer experiences within his or her farming area. In short this means the dependability of the rains, whether they are erratic or constant.

### **Rainfall intensity**

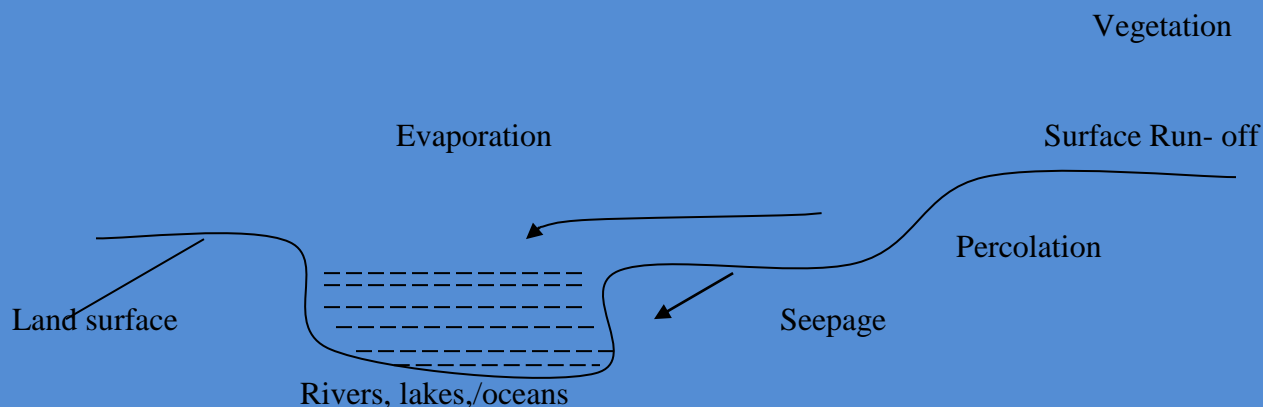
It is the amount of rainfall falling at a certain place per unit of time?

### **Water cycle**

This relates to the cyclical movement of water from the earth's surface to the atmosphere and back, as shown by the diagram below.







Water evaporates from water bodies and transpires from trees through leaves in the form of vapour into the atmosphere. As it rises, it cools, and condenses to form clouds. Later, condensation results in heavy tiny water droplets which then fall as rain.

### Natural farming Regions of Zimbabwe

Zimbabwe is divided into (5) five natural farming regions, due to the amount of rainfall received in each region. The table below shows the five natural regions.

REGION	CLIMATE	AREAS COVERED	FARMING ACTIVITIES
<b>I.</b> specialized and diversified farming	-Rainfall- From 1000mm per annum. -Temperature 20 <sup>0</sup> c	Nyanga, Cashel Valley, and Chimanimani	-Growing of crops like tea, and coffee, bananas, oranges and timber trees, -rearing of dairy cows for milk production.
<b>II.</b> Intensive Farming	-Rainfall ranges from- 750mm to 1000 mm	-Harare, Mazoe Bindura, Marondera, Chinhoyi	-Growing of different crops e.g wheat, maize, tobacco, cotton, and soya beans.
<b>III.</b> Semi Intensive Farming	-Rainfall- ranges from 650-800mm	-Gokwe, Kadoma, and Gweru	-Growing of crops under irrigation e.g. fodder crops for livestock feeding. Best for livestock production
<b>IV.</b> Semi-extensive	-Rainfall- of 450-650mm.	-Bulawayo, Masvingo	-Growing of drought tolerant crops. -Appropriate system is livestock and game ranching

V. Extensive Farming	-Rainfall of below 450m per annum	-Chiredzi, Beitbridge, Kariba, Vic Falls, Gwanda, Plumtree	-Beef-production and wildlife management, -growing of drought tolerant crops e.g. millet, sorghum.
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### Land Tenure

This refers to the ownership of land and the holding of title deeds.

### Forms or types of Land Tenure

#### (a) Communal land ownership

Land belongs to the state, but has been given to the community under the leadership of the local authority (District council). The land is used or owned communally. People do not own the land, but have ‘user rights’ over the land, but can not sell it.

(b) Leasehold- It is a contract letting a farm for a prescribed period and payment, and any other conditions. The Leaser signs a contract with the landlord giving him or her possession rights of the land for a specified period of time at a rental value.

(c) Freehold-Land belongs to an individual or a group of individuals who have bought it and have title deeds for the farm.

**NB: Title Deeds**- It is a legal document showing proof of ownership of land. The individual owns the farm and has control of the use of the farm.

### Farming systems

1. Shifting cultivation- It is the production of crops on a land which is alternated over a period, allowing the land to lie fallow for some time. It involves the clearing and burning of trees on pieces of land for planting crops. Land is abandoned 2-3 years later after the soil had lost fertility.

### Advantages

- Less build up of pests and diseases.
- High yields are obtained especially from fertile soils.

### Disadvantages

- Causes deforestation.
- Promotes soil erosion.
- Can not allow putting up of permanent structures, for example, houses or homes.
- Lots of labour is required to cut trees.

### Effects of population on land use

Too high populations of people have the following harmful effects:

- Reduced food production.
- Reduced grazing area and annual productivity.
- Increasing pressure on development resources.
- Rising unemployment.
- Pressure on energy resources.

### **Solutions on population growth**

- Family planning.
- Increased agricultural production.
- Increased industrialization.

### **Crop rotation**

It is the growing of different crops in a planned sequence on the same piece of land.

### **Principles of crop rotation**

- Crops of the same family should not follow each other.
- Deep rooted crops should follow shallow rooted crops.
- Heavy feeders should follow light feeders.
- A legume crop to be included in a rotation.
- Manure to be applied every two years.

### **Advantages of crop rotation**

- Less chances of all crops failing to mature.
- Breaks down lifecycle of pests.
- Ensures use of nutrients from all levels of the soil- due to different –rooting depth.
- Legumes fix nitrogen in the soil.

2. **Monoculture**, is the planting of the same crop year after year on the same land.
3. **Mixed Farming**, involves growing of crops side by side with rearing of livestock.
4. **Inter-cropping**, is the growing of field crops side by side, for example, field beans and maize so that maize benefits from the fertilized soil. Legumes fix nitrogen in the soil.

**NB:** Farmers can harvest different crops from the same field.

### **Questions**

- 1a) Define the following terms:
  - (i) Season length
  - (ii) Season quality
  - (iii) Rainfall intensity.
- b) Describe with the aid of a diagram how rainfall is formed.

- 2a) Distinguish leasehold from freehold as title land-ownership types.
- b) What are the advantages of crop rotation? Give four (4) advantages.

## CHAPTER 2

### NATIONAL AGRICULTURAL PROGRAMMES

#### Chapter objectives

After completing a study of the chapter, the student should be able to:

- Discuss the importance of the following agricultural programmes in promoting Zimbabwean agriculture:-
- Agriculture education.
- Department of Arex.
- Department of Research and Specialist Services.
- Non-governmental organisations.

Due to the fact that Agriculture forms the mainstay of the economy of Zimbabwe, the government and non-governmental organisations have seen it fit to support this sector through various ways. These are:-

(a) **Government institutions, which have the following departments:**

(i) **Agricultural education:**

The Zimbabwean government has made it compulsory for all pupils at secondary level to learn agriculture as a practical subject. The motive behind being that, pupils become motivated at an earlier stage to have an interest in the subject. It is also assumed that once an interest has been instilled in them, they will take up courses or pursue careers in agriculture. This will boost or increase food production in the country.

(ii) **Department of Research and specialist Services (DRSS)**

This is a department under the government which has been set up to carry out the following duties:

- Carry out research work on new and better methods of agricultural productivity, for example soil analysis as well as pest and disease identification and suitable control methods.
- Breed new animals and crop varieties that are resistant to pests, diseases, and have a high yielding capacity.

(iii) **Department of Arex**  
(Agricultural Research and Extension Services)

It is a department under the government. Its mandate is to:

- Provide advice to farmers on how best to produce crops and livestock.
- Educate farmers on theoretical and practical soil conservation, water and vegetation.
- Teach farmers on sustainable farming methods.

(iv) **Veterinary department**

It is a department under government. Its main duties are:

- Research on livestock diseases and parasites control.
- Provides extension advice on disease control (e.g. ticks) and noticeable diseases, such as e.g. Newcastle, Foot and mouth and Anthrax e.t.c.

b) **Rural Development Programmes.**

These are implemented through government institutions such as;

(i) **The District Development Fund**-It is an arm of the government whose main duties are:

- Constructing roads to link various farming points in rural areas. This facilitates quick and easy transporting of commodities e.g. maize; grain, cotton, tobacco etc.
- Drilling boreholes to supply water to communal farmers (for both crop irrigation and watering of livestock).
- Road maintenance all the times- for easy communication.
- Repairing broken down boreholes.
- Helping to conserve soils by constructing storm drains and reclamation of gullies by use of vertiver grass, or use of mesh wire

(ii) **The CAMPFIRE programme**

CAMPFIRE means -Communal Areas Management for Indigenous Resources.

-The Programme was designed in the early 1980's. It was put in place in order to ensure that the community becomes responsible and takes care of its own natural resources. The reasons are that, they would guard and protect the endangered species such as the black rhinoceros against extinction.

**Functions of Campfire**

- Educate rural communities about wildlife and vegetation management.
- Giving advice on the utilization of wildlife and vegetation.

The products of the CAMPFIRE programme are ploughed back into the community.

### **Non Governmental Organisations:**

The major ones are Windmill, ZFC, Seed Co, Cottco, GMB, Sable Chemicals, The Heifer Project International

- (i) **Windmill and ZFC** are private companies that provide inputs such as compound fertilizer and top dressing. For example, Windmill Zimbabwe is a fertilizer company that stocks and supplies, basal compound fertilizer, while Sable Chemicals manufactures Ammonium Nitrate top dressing fertilizer. Zimphos, in Harare, manufactures basal fertilizers. These companies do not only assist government in employment creation, but help in improving yields.
- (ii) **Seed-Co** is a private company that carries research in new varieties of crop seeds, and supplies large quantities of seed to farmers. This ensures that farmers continue producing food crops without interruptions that are caused by shortages of seeds.
- (iii) **Cottco** is a parastatal institution that supplies cotton seed, gin cotton seed, and also buys in bulk the cotton produced by local farmers.  
It also offers input scheme loans in the form of cotton seed, fertilizers and chemicals.
- (iv) **G.M.B (Grain Marketing Board)**- It is a parastatal body responsible for buying all cereal grain crops (maize, wheat, sorghum groundnuts, soya beans, sugar beans) from farmers. It also offers an input credit scheme to farmers in the form of seed and fertilizers. It also offers bulk storage facilities of grain in its silos spread all over the country. Areas with silos are Bulawayo; Chegutu and Lion's Den.
- v) **Sable Chemicals is a** private company that manufactures and sells Ammonium Nitrate fertilizers to different companies.
- vi) **Heifer Project International** is an international non- governmental organization operating in Zimbabwe with its Head office in Gweru. Its main purpose is to donate animals (heifers) to identified needy areas or regions. The aim is to re-stock or re-build the national herd which was seriously affected by the drought of 1992.

### **Revision questions**

- (1) Discuss the importance of the following agricultural programmes in promoting Zimbabwean agriculture:-
  - (a) Agriculture education.
  - (b) Department of Arex.
  - (c) Department of Reserves and Specialist Services.
  - (d) Non-governmental organisations.

# CHAPTER 3

## CROP HUSBANDRY

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Distinguish soil texture from soil structure.
- Give five characteristics of:
  - Sand soil
  - Loam soil.
  - Clay soil
- Describe each of the following soil water types:
  - Free water
  - Capillary water
  - Hydroscopic
  - Bacteria
  - Earthworms
- List five ways of reducing effects of high temperature on soils.

### Soil Formation, Texture and Structure

#### What is soil?

It is a loose layer of material that covers the earth's surface or, a medium where plants grow on soil for survival, be it plant or animal. A gram of soil takes millions of years to be formed. It is for this reason that we need to conserve soil. Soil is formed during the process of weathering.

### **Types of Weathering**

- (i) **Water action:** Water that accumulates in cracks of rocks, freezes during the night. This causes rocks to expand thereby peeling off at night. The sudden contraction of rocks causes them to crack and peel-off. This is called **exfoliation** (the peeling off of rocks). This type of weathering breaks down rocks into soil faster than all other methods.
- i) **Chemical weathering.** It is the breakdown of rocks through chemicals that dissolve minerals in them. When carbon dioxide in the atmosphere mixes with rain water during a storm, a weak acid called carbonic acid is formed. This weak acid tends to eat away the rock causing it to break down into fine particles, hence, soil.
- ii) **Biological weathering.** It is the break down of rocks due to living organisms i.e. either ants, or earthworms or plant roots. Ants burrow into rocks and make holes. Water enters into the hole and during the night it freezes, thereby causing expansion and the rock cracks and peels off. As plant roots grow, they open up more space between them. This allows more water to enter. This water freezes at night causing rocks to break off.

### **Main Rock types from which soil originates**

There are three types of rocks from which soil originates, namely,

- (i) Igneous
- (ii) Sedimentary
- (iii) Metamorphic

#### **Igneous Rock-**

These are rocks that appear to have crystallised from magma below the earth's crust surrounded by pre-existing rocks. Bodies of igneous rocks are exposed to the surface after erosion and the usual uplift.

- b) **Sedimentary Rocks-** Rocks formed from Sediments which have been deposited on minor beds over a long period. As water flows, particles are laid down (deposited). In Layers.
- After several years the sediments form rocks. Examples of rocks under sedimentary are: Limestone (chalk) sand stone.
- c) **Metamorphic-** Rocks formed due to changes in intense heat and pressure exerted on different rocks i.e. an igneous or sedimentary rock can change into a metamorphic rock ix exposed to intense heat and pressure. Examples of rocks are Gneiss, schists, quartz slate, marble.

#### **Agents of weathering:**

- Wind,
- Water
- Temperature.



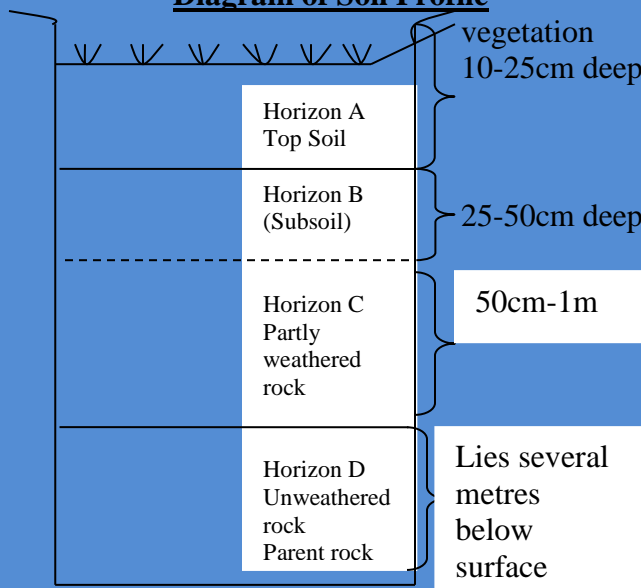
### Factors affecting weathering

- (i) **Parent rock:** It is the rock from which soil originates. If the parent rock is hard, it will take several years for the soil to be formed from that rock. If rock is soft, it will quickly break down to form soil.
- (ii) **Temperature:** Temperature ranges have a bearing on rock formation. If very high temperatures are experienced during the day, and very low during the night, then rocks will quickly break down to form soil.
- (iii) **Water:** If rocks are continuously exposed to water, they will quickly break down to form soil, and if not, they will also take time to break down.
- (iv) **Plant and animal activity.** If rocks are exposed continuously to ants and earthworms activity then, they will break down quickly.

### Soil Profile

It is the vertical section or cut, made through the soil, extending from the surface to the underlying rock.

#### Diagram of Soil Profile



**Horizon A (Top Soil)**- Is the upper most layer of soil.

- Has a lot of nutrients from plant food.
- Is darker in colour due to organic matter.
- Many plant roots are found here.
- High level of microbial activities.

**Horizon B. (Subsoil)**

- Is lighter (orange) in colour due to less organic matter.
- Few plant roots extend to this zone.
- Contain little plant nutrients.
- Can be mixed with top soil useful for farmers

**Horizon C (partly weathered rock).**

- Consists of partly weathered rock it has loose gravel.
- Not useful to farmers.

**Horizon D (Unweathered rock)**

- Consists of unweathered rock
- Lies several metres below.

### Importance of the soil profile

Determining a soil profile is important for the following reasons:

- Determine soil colour, structure and texture.
- Assess the root status of the soil.
- Determine moisture content and drainage of soil.
- Assess the effective depth of each horizon.

**Revision Questions:**

1. Define the following terms (a) Soil (b) Weathering (c) Soil profile.
2. Draw and label a diagram of a soil profile.
3. Briefly describe each of the following horizons (layers) of a soil profile:
  - (i) Top soil.
  - (ii) Subsoil.
4. Describe the process of physical (mechanical) weathering.

**Soil texture:**

It is the coarseness or fineness of a soil, or the “feel” of the soil. Soil texture is also defined as the proportion of different mineral sized particles in a given soil. Soil texture cannot be altered by a farmer.

**Methods used to determine soil texture.**

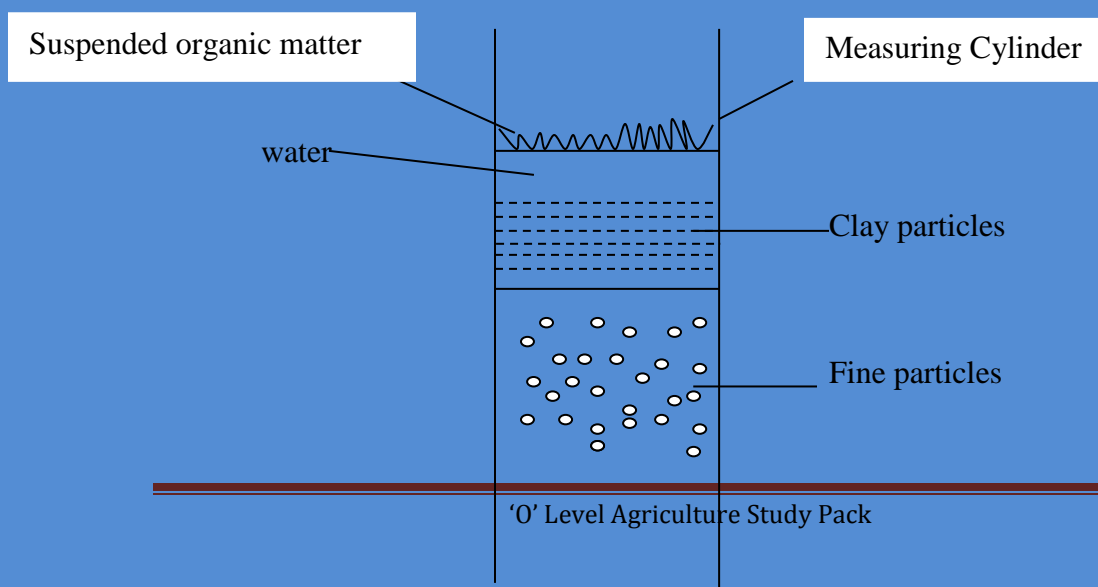
- (1) The feel method- With this method the procedure is as follows:
  - Take a soil sample.
  - Add water to the sample to make it wet.
  - Take a wet soil sample and place it between thumb and forefinger, and rub it or squeeze.

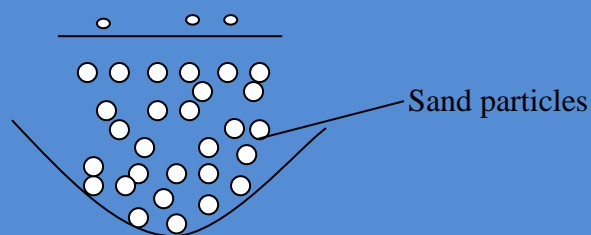
You will notice that it either “feels” smooth, or it is rough on fingers. This will show the amount or quantity of clay or sand soil in it. If it is smooth, it is clay soil, and if rough, it is sandy soil, that is, it either contains too much clay or sand respectively.

**2. Mechanical Analysis of soil samples or the Laboratory Method**

The following procedures are followed during the laboratory method of soil sampling analysis:

- (a) Take a soil- sample measuring cylinder and water.
- (b) Put soil sample into a cylinder of 100mm
- (c) Add the soil sample into cylinder with water.
- (d) Thoroughly shake the contents.
- (e) Leave the contents for about 2 hours.

**Soil Texture Diagram**



### **Observations:**

The particles will deposit themselves in layers at the bottom of the measuring cylinder, because they are heavier and denser as shown in diagram above.

The second layer is made up of fine sand particles.

The Third layer: clay particles

**Textural classes:** The textural classes of the different mineral sized soil particles can be classified as follows:-

Particle type	Size
Sand	2 to 0,2mm
Fine Sand	0, 2 to 0,02mm
Silt	0,02mm to 0,002mm
Clay	>0,002 mm

### **Ways of improving soil structure:**

Soil structure can be altered by man through the following processes:

- (i) **Apply lime:-** Lime makes fine soil particles to flocculate i.e., to come together. It is usually applied in clay soils whose particles are closely packed together. Therefore, once applied in clay soils, it improves its structure.
- (ii) **Manure application:** They are also applied in clay soils. Manure has a tendency to make particles stick together, thus allowing particles to become bigger.
- (iii) **Avoid monoculture.** Monoculture is the growing of the same crop on the same piece of land year in, year out. Hence, if one grows different crops, other crops such as ground nuts tend to bring soil particles together.
- (iv) **Avoid untimely cultivation.** It is good cultivate when soils are neither too dry nor too wet.

### **Problems of soil structure**

Soil structure has several problems. Chief among them being,

- (i) Capping
- (ii) Compaction
- (iii) Soils pans

- (a) **Capping.** This is a thin hard layer formed on the top/upper surface of the soil. It is usually caused by working on soils, especially clays, when they are too wet or when it is raining

### **Effects of capping on crops**

- (1) There is usually poor germination of seed because of the crust above.
- (2) There is poor aeration, resulting in poor plant growth.

### **Solution/ways to solve capping**

- Use a harrow to break the crust.
  - Avoid working fields when soils are too wet and when it is raining.
- b) **Compaction.** It is the hard layer on the upper surface of soils caused by heavy machinery when ploughing e.g. tractors.
- c) **Soils Pan.** It is a hard layer found at the base of the plough depth due to maintaining the same plough-depth year in year out.

### **Types of soils**

#### (a) **Sand**

### **Properties and characteristics**

- Have large particles.
  - Have a low water holding capacity.
  - Have a higher leaching rate of plant nutrients.
  - Have fewer plant nutrients.
  - Does not stick to implements when wet?
  - Is loose and easy to work on.
- (b) **Clay**  
**Characteristics**
- Contains very small particles (of clay and silt).
  - Difficult to cultivate when wet or too dry.
  - Has good water holding capacity.
  - Is poorly drained.
  - Has poor aeration.
  - Sticks to implements when wet.
- (c) **Silt**
- Cultivation is reasonably difficult.
  - Drainage is reasonably poor.

- Has a poor aeration or ventilation.
- Has a poor water holding capacity.
- Leaching is high.

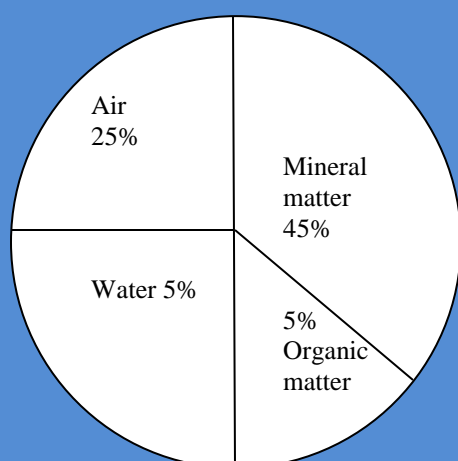
(d) **Loam**

- Very fertile.
- Well aerated soil.
- Is well drained.
- Has favourable soil temperature.
- Easy to cultivate.
- Does not stick to implements when wet.
- Very Low leaching rate.

**Soil constituents**

Soil is composed of particles of rock, (mineral matter) organic matter, water, air, and living organisms.

**Pie chart showing soil constituents**



(i) **Organic Matter**

They play an important role in the soil and its support on plants. Its importance can best be understood in terms of its functions.

**Functions**

- Improves soil fertility.
- Improves aeration.
- Creates favourable soil temperatures.
- Increases microbial activities.
- Improves drainage.

(ii) **Water.**

This is a crucial component in the soil and for the life of living organisms.

### **Functions**

- Dissolves mineral salts and nutrients to facilitate uptake by plants.
- Regulates soil temperature.
- Assist in the weathering of rocks.
- Enhances cooling of plants during transpiration.

### **Types of water/Moisture**

#### (a) **Free or Gravitational water**

This is water found on the soil soon after rain or irrigation. It can not be held by soil, instead of infiltrating into the soil. It is not ready for use by plants soon after irrigation or rainfall.

#### (b) **Capillary water**

This is found in moist soils. It is held by the soil particles in their layers around them. Plants make use of it. It is not tightly held by the particles, and evaporates well under normal temperature.

#### (c) **Hydroscopic water**

This is water in a form of a gas, found in very dry soils. It can not be used by plants. It is tightly held around soil particles, and does not evaporate under normal temperature.

#### (iii) **Soil air.**

This is an essential component for the welfare of plants.

### **Functions**

- For respiration by both soil organisms and plants
- Oxygen is vital for germination of seed.
- Held in weathering of rocks

#### (iv) **Living organisms.**

They perform a variety of activities in the soil. These living organisms are:

(a) **Bacteria and Fungi** responsible for the decomposition of dead plants and animals to form humus.

(b) **Earthworms/Termites and Ants which** burrow into the soil to improve aeration and drainage. They put vegetative matter into the soil, which the later decomposes to form humus.

### **Soil Temperature**

#### **Effects of soil temperature on plants**

If temperature is above the optimum level, it shortens the growing period of plants, resulting in low yields. It can also cause plants to grow exceedingly tall and thin. Flowering and seeding can be reduced.

### **Temperature below optimum**

- Causes slow growth in plants.
- Plants fail to ripen resulting in no seed produced.

### **Methods of reducing effects of extreme Temperature**

#### **Extreme temperatures can be reduced by the following processes:**

- Mulching beds.
- Planting cover crops.
- Irrigate arable lands.
- Grow wind breaks.
- Shade newly transplanted seedlings.

### **Questions**

- 1(a) Distinguish soil texture from soil structure.
- (b) How can a farmer maintain a good structured soil?
- (c) Give five characteristics of:
- (i) Sand soil
  - (ii) Loam soil.
- 2(a) Describe each of the following soil water types:
- (i) Free water
  - (ii) Capillary water
  - (iii) Hydroscopic
- (b) What is the importance of the following soil organisms in agriculture?
- (i) Bacteria
  - (ii) Earthworms
- (c) List five ways of reducing effects of high temperature on soils.

# CHAPTER 4

## SOIL SAMPLING

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- List (2) two reasons for taking soil samples from fields.
- Identify two tools used when taking samples.
- Give the benefits of having optimum pH in arable lands?

### Definition

Soil sampling is the taking of a representative soil quantity from a piece of land in order to determine soil pH and nutrient status. pH is a measure of the concentration of hydrogen ions ( $H^+$ ) and Hydroxyl ions ( $H^-$ ) in a given soil solutions. pH stands for potential Hydrogen, or a measure of acidity or alkalinity of a soil solution.

### Guidelines to follow in soil sampling

- i) Leave about 5metres of land at the edges of the field.
- ii) Take ten sub samples from the whole field. At each sub sample collect about 10-20 grams of soil.
- iii) Sample from different parts of the field so as to get a true representation of the whole field.
- iv) Avoid ant-heaps and edges of the field because they are fertile.
- v) Take samples during the months of May- June when soils are dry.

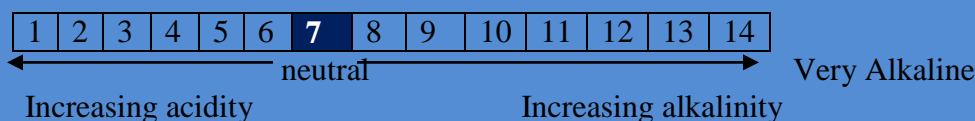


### **Procedure (Steps) to follow in sampling**

- Sample using a spade shovel.
- Dig a V-shaped hole to a depth of 17,5cm.
- From the V-shaped hole, get the soil from both sides of the hole (about 10-20grams).
- Repeat step C above for all the ten sub-samples.
- Mix the soil from the 10 sub-samples thoroughly.
- Allow the soil to dry out and take 1kg of soil. Put it in the soil cardboard box, as representing the field sample. (composite sample)
- Label the box with your name and address.
- Post/deliver the sample to: Soil-test Laboratory, P.O.BoxCY500, Causeway, Harare.

### **pH Measurement scale**

pH is measured using a calcium chloride scale or a pH scale chart as shown below



### **pH levels**

- From 1 to 6- Acidic
- 7- Neutral soil
- From 8- 14- Alkaline

**NB:** For arable Lands, optimum pH is at 5,5 to 6, 5.

-Most plants grow well at slightly acidic pH 5,5 to 6,5 neutral; because:

- Most nutrients are available and easily realized from the soil.
- Microbial activity is higher
- Fertilizer are most effective

### **Causes of acidity**

The following can be listed as the main causes of acidity in soils:

- Parental material
- Fertilizer which contain sulphur and other farming acids e.g. urea
- Poor drainage
- Continuous cropping, that is, particular bases, like magnesium and calcium are taken from the soil.

### **Correction of acidity**

You apply lime. It neutralizes acidic soils e.g. dolomitic limestone, ground limestone, quicklime.

### **Importance of lime**

- Neutralizes acidic soils.
- Flocculates poorly structured soils.
- Add nutrients like magnesium and calcium into the soil.

- Important for bacterial action e.g. fixing nitrogen in the soil.

### Causes of Alkalinity

- Parent rock in the geological composition of the soil
- Low rainfall
- Poor drainage (encourages excess formation of hydroxides)

### Questions

1(a) List (2) two reasons for taking soil samples from fields.

(b) Identify two tools used when taking samples.

(c) How can a farmer correct an acidic soil in his garden?

2. What are the benefits of having optimum pH in arable Lands?

# CHAPTER 5

## SOIL FERTILITY

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Distinguish between a straight and a compound fertilizer.
- State the advantages and disadvantages of a compound fertilizer.
- State the benefits that are derived from use of farm yard manure.
- Give the reason for watering each compost layer during its making.
- Identify crops which are ideal for use of green manure and why.
- State three methods of applying fertilizers.

### Plant Nutrients

These are elements important for plant growth. They are divided into two major groups:

- Major/Macro Nutrients which are required by plants in large quantities for example nitrogen, phosphorous, potash.
- Trace/micro/minor nutrients, are required by plants in smaller quantities e.g. boron, sulphur, copper and zinc

## Major nutrients

### 1. Nitrogen

It gives plants a rich and dark green colour and stimulates the whole plant to grow bigger and faster. It also facilitates the growth of stems and leaves.

#### Symptoms of Nitrogen deficiency

The following are common effects on plants that have nitrogen deficiency:

- Plants are stunted/and retarded.
- Causes early flowering and seed setting.
- Causes yellowing of leaves of plants.

Excess nitrogen may also have its own negative effects on plants. Among other effects, excess nitrogen may,

- Cause a soft, sappy growth and leads to lodging in cereals.
- Increase susceptibility to pests and diseases and lowers resistance to frost.
- Retard ripening in cereals and slow down the formation of seeds.

#### Nitrogen in the soil

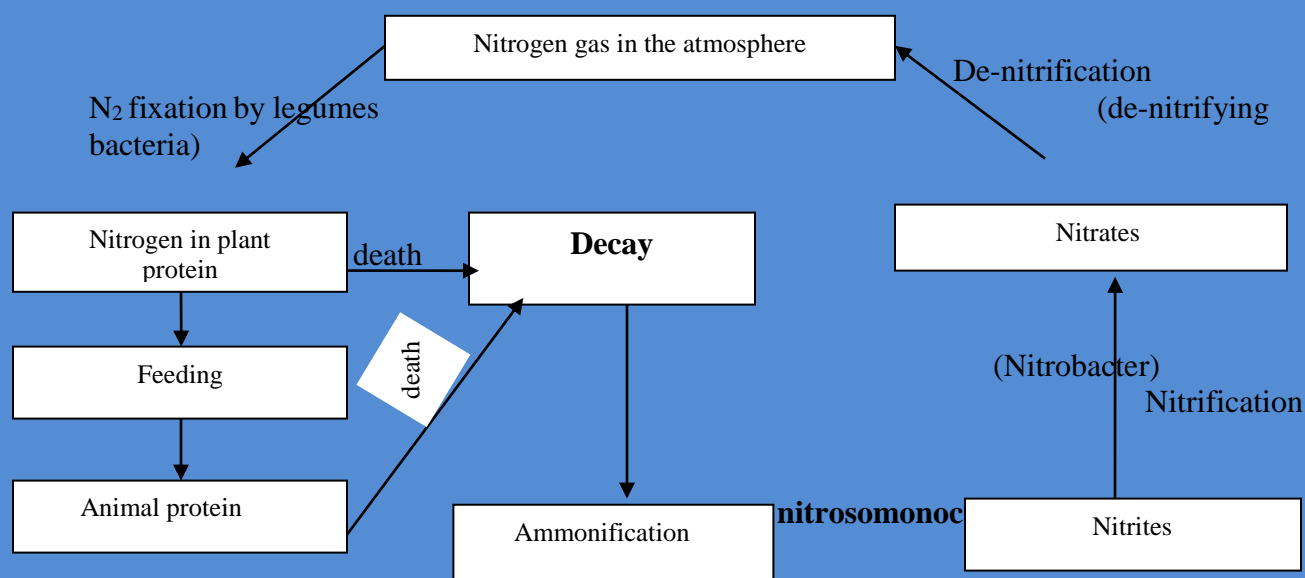
It appears in the soil in three (3) forms:

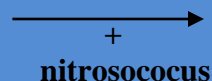
- These are:
- (a) Ammonia gas
  - (b) Ammonia ions
  - (c) Nitrates

### 1. Nitrogen cycle

- Atmospheric nitrogen is fixed into soil by rhizobium bacteria
- Rhizobium bacteria stay in leguminous plants, for example groundnuts.
- Bacteria get carbohydrates from legumes and they supply legumes with nitrogen.

The nitrogen cycle in plants can best be described by a diagram as below:





### **Explanation of the diagram**

Nitrogen fixation: Atmospheric nitrogen is fixed into the soil by the bacteria called rhizobium, found in root nodules of all legumes. The nitrogen in plant protein is taken in by animals through feeding processes. The animals contribute animal protein. Plants and animals die and decay to form ammonium compounds.

The bacteria called nitrosomonas and nitrosococcus act on ammonium compound to form nitrites. Nitrites are not used by plants because they are poisonous. The Bacteria called nitrobacterium acts on nitrites to convert them into nitrates which are usable by plants. The denitrifying bacteria act on nitrates to obtain oxygen for respiration. The nitrogen released from nitrates is further released into the atmosphere.

### **How nitrogen is lost from the soil.**

The following processes facilitate the loss of nitrogen from the soil:

- It is lost through:
  - Leaching: This is the washing away of nutrients by water infiltrating the soil.
  - Plant up take: Plants use up nutrients as they grow.
  - Soil erosion: This is the washing of top soil by water and wind.
  - Volitization: This refers to loss of nitrogen in the form of gas.
  - Burning of residues of crops: This deprives the soil of the manure that would have formed from rotting husks.
  - Dentrification: It is a process where denitrifying bacteria breaks down nitrates into nitrites resulting in nitrogen gas going into the atmosphere.

## 2. **Phosphorous**

This is a chemical compound that is necessary for the healthy growth of plants. Its common functions are,

- Promoting fertility of plants.
- Promoting short term growing period of crops.
- Stimulating the quick root system of crops.
- Increases true nutritive value of crops.
- Increasing crop resistance to diseases.

### **Deficiency of Phosphorous**

This refers to a critical shortage of the compound phosphorus in plants. The shortage will have negative effects, some of which are,

- Cereals turn bluish green in colour.
- Fewer flowers and less fruit produced.
- Poor root system.

### **Sources of phosphorous**

- Rocks. Certain types of rocks have in them the chemical compound of phosphorous. They may be crushed into powder to obtain phosphorous.
- Fertilizers, e.g. single super phosphate, double super phosphate.
- Organic matter.

### **Excess Phosphorous.**

If phosphorous becomes too much in the soil, they will be negative effects on the plants. It will become poisonous to plants. It will also suppress the uptake of other nutrients.

### **3. Potash**

This is sometimes known as ash. It is found in burnt down organic substances. Potash keeps leaves in a healthy condition, improves the quality of crops and makes crops more resistant to serial diseases.

### **Deficiency of Potash**

This refers to what happens if there is a shortage of potash in plants. The following negative effects will appear:

- Leaves appear scotched on leaf margins.
- Poor formation of tubers in potatoes.
- Poor grain formation.
- Increased lodging of plants occurs.
- Poor overall growth of the plants.

### **Effects of excess of potash**

Potash in excess, is when there is more than necessary of the chemical potash in the soil. It suppresses the up take of magnesium.

Sources of potash are:

- Rocks
- Organic matter
- Fertilizers for example potassium chloride
- Wood ash
- Sea weed

### **Factors influencing availability of nutrients**

Several factors influence the availability of nutrients in the soil. The following factors are very common in this regard:

- Soil pH. When soil is very acidic, it turns to affect microbial activity.
- Soil type. For example, sandy soil is more prone to leaching because of big particle sizes.
- Organic matter. It tends to allow nutrients to cling to it, hence making it available to crops.
- Plant Species. The rooting system of plants differs. For example, Rapoko crop has dense fibrous root hairs, hence they explore a large surface area for nutrients.

### **Questions**

1(a) Define, using examples the meaning of the following terms:

- (i) Major nutrients.
  - (ii) Micro nutrients.
- (b) Discuss nitrogen under the following headings:
- (i) Functions
  - (ii) Deficiency signs/symptoms
  - (iii) Oversupply signs/symptoms
2. What do you understand by the following terms:
- (a) Ammonification
  - (b) Nitrification
  - (c) Dentrification
  - (d) Fixation.

### **Fertilizers**

Plant nutrients are supplied in two main forms. These are grouped as, organic and inorganic fertilizers.

### **Inorganic fertilizers**

They are man-made fertilizers in the form of compound and straight fertilizers (salts) applied to the soil to promote plant growth, and fruits formation.

### **Advantages of using fertilizers.**

- They are sold in granules, each granule containing either a straight fertilizer or a mixture
- They are well mixed, with no lumps.
- Fertilizers are easy to handle and work on.
- They are easy to store in bags for several years
- Fertilizers are easy to spread.
- They are a balanced mixture.

### **Disadvantages of using fertilizers**

Fertilizers can be very expensive. They can burn crops if not properly used or if they are applied in excess. Fertilizers do not improve the soil structure. They also do not last for years in the soil.

### **Types of inorganic fertilizers**

1. **Compound Fertilizers** contain (3) three major nutrients, for example, nitrogen, phosphorous, and potash. They are applied to the field during land preparation period or before.
2. **Straight fertilizers** contain one major nutrient, for example ammonium nitrate which is applied when plants show deficient signs (Turning yellowish).

### **Types of straight fertilizers**

- (a) Nitrogenous straight fertilizers:

- (i) Ammonium nitrate
- (ii) Urea
- (iii) Ammonium Sulphate
- (iv) Sodium nitrate

(b) Phosphatic straight fertilizers

They are found in two types as follows:

- Single super phosphate
- Double super phosphate

(c) Potassic straight fertilizers

They are found in three types as follows:

- Potassium chloride
- Potassium sulphate
- Muriate of potash

### Stages of applying fertilizers

They are two basic stages when fertilizers can be applied. These are:

- (a) Topdressing, which is the application of any straight fertilizer after deficient signs have been shown. This type of fertilizer is applied at certain stages of the plant growth, for example, at the time of flowering in tomatoes in particular
- (b) Basal/Initial Dressing. This refers to the application of fertilizers (compound) before or at planting.

### Methods of applying fertilizers

Four methods of applying fertilizers are noted below:

- Broadcasting. It is the applying of fertilizer by scattering or showering it all over the field. It is not commonly used by communal farmers, but is used by commercial farmers as basal dressing and top dressing, when growing wheat and barley
- Banding. It is the applying of top dressing by spreading it along the row. It is wasteful.
- Hill placement. This is the placing or application of top dressing next to the plant
- Foliar application. It is the application of fertilizer on the leaves of a crop e.g. gypsum in groundnuts

### Organic fertilizers

They are derived from dead decomposed plant and animal matter e.g. compost, humus, etc. Decomposition is brought about by bacteria.

### Advantages of organic manure

- They improve the soil structure.
- They remain in the soil for two to three years
- They store water in soil for long times
- They help to steady the supply of nutrients to plants

### Disadvantages

- They do not cover large areas.
- Application of organic manure is labour intensive.
- Organic manure is not readily available. It promoted rapid germination and growth of weeds because weed seeds will often be in the manure.

### **Examples of organic fertilizers**

They are basically three types of organic fertilizers. These are:

1. **Compost.** This is manure of decayed organic matter, made of various plant and animal matter. This type of manure is found in the form of, pit compost and heap compost. Pit compost is made by digging a pit, dumping organic matter in it, covering up with soil and left to rot. Heap compost is formed when organic matter are heaped up and left to decompose or rot.
2. **Farm Yard Manure.** It is a mixture of livestock droppings (dung) with plant materials like grass used for animal bedding, for example, stable manure from horses, kraal manure.
3. **Green Manure.** This is obtained from a crop buried or ploughed down whilst at flowering stage, for example, a leguminous crop, because of their ability to fix nitrogen in the soil.

### **Questions**

- 1a) Distinguish between a straight and a compound fertilizer
- b) What are the advantages and disadvantages of a compound fertilizer?
- 2a) What benefits are derived from use of farm yard manure?
- b) What is the reason for watering each compost layer during its making?
- c) What is the best time for ploughing green manure underneath?
- 3a) Which crops are ideal for use as green manure and why?
- b) State three methods of applying fertilizers.



# CHAPTER 6

## SOIL EROSION

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Explain the term soil conservation.
- Explain how a farmer can control wind erosion
- Describe the effects of water erosion.
- Distinguish erosivity from erodibility.
- Identify four causes of erosion on arable lands and suggests possible solutions to the problems.

### Definition

Soil erosion is the washing away of loosened top soil by wind and water to places where plants cannot use it.

Conservation of soil refers to the care given to land so as to preserve the natural resources in their natural state. It is the wise use of soil to ensure that it maintains its fertility and productivity for next generations.

**Agents of erosion**

These are:-

- Wind
- water

**Land degradation**

Land degradation is the destruction or damage of land, or the unwise use of land such that it loses its value, or deteriorates, and productivity is lowered. It is caused by both human activity and natural factors.

**Human Activities that cause land degradation.**

- Mining. For example, gold panning. People search for valuable minerals such as gold and diamonds digging wantonly river beds and river banks.
- Road construction. During construction of new roads, trees are up rooted, masses of soils are moved. Gravel quarry is dug living large open pits, deforming the land structure.
- Building and brick moulding activities. Break molders destroy the natural land surface as they do bricks for construction of houses.
- Deforestation. People may cut trees indiscriminately, especially in newly resettled places.
- Firewood. People generally use firewood as a form of fuel. The demand for firewood results in forests degradation.
- Cultivation. People may open up new lands for cultivation purposes thereby cutting down trees, ploughing along the slopes, resulting in land degradation.
- Overstocking. People may keep a livestock population that can not be accommodated in a particular land section. As a result the live stock will degrade the land and the whole ecosystem.
- Use of sledges. People may pull sledges or sleighs, swiping the land surface, causing land deformation.

**Natural Factors that cause land degradation**

- Strong winds.
- Cyclones- and floods.
- Earthquakes and mudslides.
- Droughts.

**Wind erosion**

It occurs on areas with poor vegetative cover, with poor root systems. Vegetation can act as a wind break.

**Methods of wind control**

In farming, the effects of wind action can be controlled by planting trees on bare lands. Appropriate farming methods can also help to avert adverse wind action, for example, strip cropping and stubble mulching.

**Disadvantages of Windbreaks**

Trees take water and nutrients away from the crops, depriving them of moisture. Trees provide shade to field the crops causing the effect of thinning of plants. Wind breaks disturb aerial spraying, when a farmer wants to use an aircraft to spray the crops.

### **Water erosion as an action of degradation**

- It is caused mainly by running water.
- Destroys the soil surface and breaks soil crust
- Causes capping
- Flattens the soil and promotes excessive run off
- Reduces nutrient-holding capacity of the soil.
- Reduces the infiltration rate of water into the soil

**Erositivity** can be defined as the ability of rain to cause erosion. Rain drops loosen soil particles easily.

**Erodibility is** the susceptibility or vulnerability of the soil to erosion. It is affected by texture and structure, topography and land management.

### **Types of erosion**

There are three types of erosion, namely; sheet erosion, finger erosion and gully erosion.

Sheet erosion takes place on a larger area of thin top soil.

Finger erosion makes small tunnels in grazing lands.

Gully erosion results in dongas or gullies being formed

### **Causes of erosion in arable lands**

Erosion is caused by the following:

- Poor crop cover which leaves top soil vulnerable to the effects of running water.
- Ploughing along the slopes which results in an increase in running water speed.
- Stream bank cultivation which promotes faster runoff of the soil on steep gradient.
- Absence of contour ridges results in more speed and erosive power of running water to carry top soil.
- Broken contours allow the water to escape with force through breaks on the contour and washing away soil.
- Use of heavy machinery destroys soil structure and the soil becomes susceptible to erosion.
- Monoculture. If same crops are continuously grown on the same land, for example sugar cane, they have the effect of loosening the soils resulting in an easy exposure of the soil to erosion.
- Burning crop residues. Crop residue acts as ground cover, hence if burned down, the ground is left without cover and erosion takes place.

### **Biological control of erosion in arable lands**

A number of biological methods are used to control erosion in arable lands. The most common methods are:

- Intercropping. Some crops can be cover- crops, for example, groundnuts can be intercropped to maize.

- Early planting. Planting early can establish cover on the ground before heavier rains.
- Practising crop rotation. Some crops have better rooting systems which help to improve soil structure, for example legumes are good cover crops.
- Maintaining optimum plant populations. This assists in covering the whole ground.
- Mulching. This involves leaving organic matter on the ground, thus covering the ground.
- Applying enough fertilizer to ensure good crop cover and soil particle bondage.
- Avoiding monoculture.
- Ploughing across the stream.
- Avoiding stream bank cultivation

### **Causes of erosion on grazing lands**

Both, human and animal activities can cause erosion on grazing lands. The following actions can be listed:

- Tracks caused by livestock.
- Pulling sleighs/sledges.
- Veld fires.
- Overgrazing.
- Heavy rains/floods.

### **Biological control of erosion on grazing lands**

- Avoid overgrazing and overstocking.
- Avoid veld fires.
- Avoid pulling sleighs.

### **Questions**

- 1a) List 4 human causes of erosion
- b) Explain the term soil conservation
  
- 2a) How can a farmer control wind erosion?
- b) How does water erosion cause erosion on land?
  
- 3a) Distinguish erosivity from erodibility.
- b) Identify four causes of erosion on arable lands and suggests possible solutions to the problems.

### **Advantages of the biological control methods**

- They are cheap to implement.
- They are easy to carry out since it is part of normal crop and animal practices.
- They help contribute to the increase of plant populations and animal productivity.
- They do not interfere with machinery operations.
- They do not affect the size of arable land.

### **Disadvantages of the biological control methods**

- Biological methods can fail to control very heavy storms particularly early in the season before there is adequate vegetative cover.
- Use of grass mulching can bring weed seeds into lands.

- High plant populations can result in yield reduction due to competition for nutrients, water, and light.

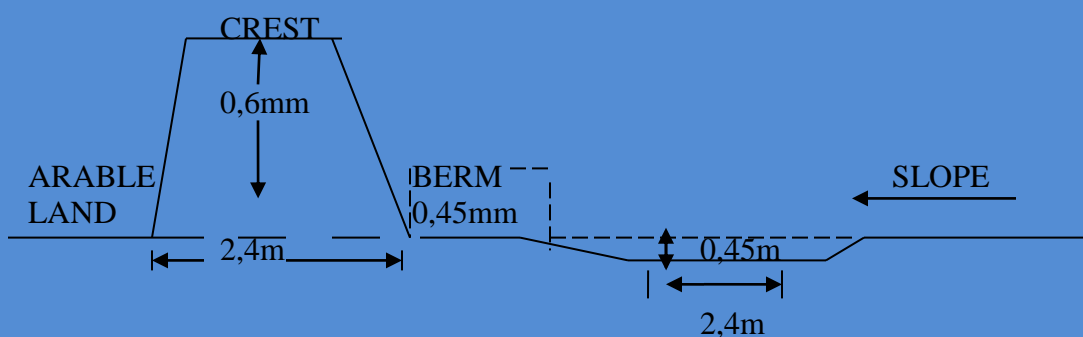
### Mechanical conservation/control methods

- This involves the use of structures constructed in and outside the arable lands to help control flow of storm water.

### Examples of mechanical conservation

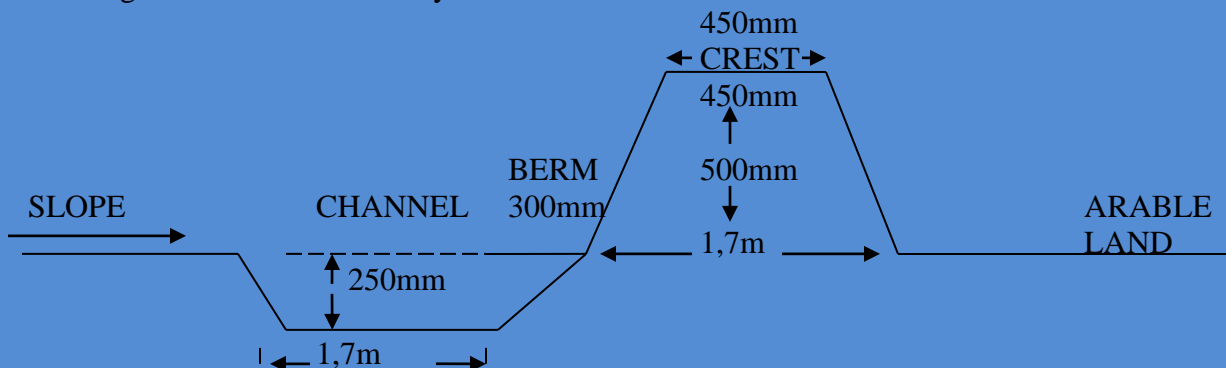
#### (i) Storm drains

These are mechanical structures dug at the upper land of the field to catch and divert storm water to the waterways.



#### (ii) Contour ridges

These are mechanical structures that are constructed inside fields to collect surface runoff and discharge this water to waterways.



### Other examples of conservation methods

These include:

- Benched terraces- constructed on steep slopes.
- Gabion baskets/cages
- Rock bolstering.
- Tied ridging
- Waterways.
- Contour ploughing

- Grass buffer strips.

### **Advantages of mechanical control**

The one single advantage of the mechanical control method is that it is more effective.

### **Disadvantages**

There are more of disadvantages than advantages of the mechanical method of control. The construction of conservations structures such as storm drains are difficult to design and construct. They take considerable part of arable land. If poorly designed, they can fail completely.

### **Ways of reclaiming gullies**

- Rock bolstering
- Gabion baskets/cages
- Sand bag pitching
- Planting runner grasses, or vertiver

### **Negative effects of erosion**

- Siltation of dams, rivers etc. This affects the capacity of dams resulting in less water for irrigation and for animals.
- Poor yields.
- Water, land and atmosphere pollution.
- Dusty clouds in the environment
- Muddy flowing water

### **Questions**

- 1a) What are the advantages of the following erosion control methods:
  - i) Biological control?
  - ii) Mechanical control?
- b) Distinguish storm drains from contour ridges
- 2a) List four mechanical control methods, other than storm and contour ridges.
- b) What are the effects of erosion?
- c) Draw and label a diagram of a contour ridge and label it fully.

# CHAPTER 7

## WATER CONSERVATION

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Explain the term water conservation.
- Show why it is important to conserve water.
- List any two sources of water.
- State (5) five ways of conserving water in arable lands.
- Describe the harmful effects of water pollution.
- Explain the purpose of the Zimbabwe Water Act (1976).

### Definition

It is the wise use and preservation of water for agricultural purposes.

### Importance of water conservation.

- Helps crops to grow faster and healthier
- Provide water for irrigation purposes, drinking and watering of animals
- Prevents and avoids excessive leaching and runoff
- Reduce soil erosion.

### **Uses of farm water**

- (i) Farm water is used primarily for human and livestock consumption.
- (ii) For secondary use, it is used for irrigation purposes.
- (iii) For Tertiary uses, it is used in industries and mining sectors.

### **Sources of water**

-Water sources can either be natural or artificial. See table below:

<b>Natural</b>	<b>Artificial</b>
-Rivers	-dams
-Streams	-Wells
-Springs	-Boreholes
-Natural rains	-Ponds
-Springs	-Harvested water in tanks
	-Weirs

### **Ways of water conservation on arable lands**

These are:

- Contour ploughing helps in water infiltration into ploughed land.
- Addition of organic matter acts as a sponge in keeping water.
- Mulching by leaving stones scattered all over the field.
- Minimum tillage
- Terracing
- Tied ridges
- Pot holes dug between rows of crops. Pot holes are holes dug at random using a hoe. They can be dug between rows of crops. They allow water to accumulate, thus reducing surface runoff.

### **Water pollution**

It is the contamination of water sources by chemicals, fertilizers, detergents and sewage

### **Causes of water pollution**

- Chemicals and fertilizers from industries. They can be applied to crops, then washed into the soil, to the rivers and dams there by posing a health hazard.
- Sewage deposited into water sources

### **Effects of water pollution**

- Affects aquatic life e.g fish.
- Leads to diseases e.g bilharziasis
- Leads to Eutrophication (overgrowth of microscopic aquatic plants and green algae which absorb oxygen for fish and other animals, leading to massive death and upsetting the ecosystem.

### **Water treatment**

Common methods of water treatment are:



- Water settling
- By filtration
- By chlorination

### **Water storage**

Water is harvested and stored in:

- (i) Dams, lakes, weirs, seas, oceans.
- (ii) Tanks. They can be of plastic, bricks or zinc mounted on a raised platform.
- (iii) Ponds.
- (iv) Boreholes and wells.

### **Water legislation.**

This refers to the law regulating the use of water in the country.

In Zimbabwe, water use is controlled through the Water Act of 1976 whose purposes are:

- (i) The prevention of water pollution
- (ii) All irrigation systems should be approved by the state
- (iii) Makes sure that extraction of underground water is controlled by the state.
- (iv) Right to use public water is granted by the state
- (v) Apply for water rights before setting up irrigation projects.

### **Questions**

- 1a) Explain the term water conservation.
- b) Why is it important to conserve water?
- c) List any two sources of water.
- 2a) State (5) five ways of conserving water in arable lands.
- b) What are the harmful effects of water pollution?
- c) What are the purposes of Zimbabwe Water Act (1976)?

# CHAPTER 8

## DRAINAGE

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Define drainage.
- Describe water logging and its causes.
- State the harmful effects of water logging.
- Give the reasons for draining waterlogged soils
- Describe how excess water is drained through mole drain pipes.

### Definition

Drainage is the removal of excess water to create favourable soil conditions for both plants and soil organisms.

### Sources/causes of water logging

- Heavy rains or down pours.
- Excess irrigation, especially if irrigation pipes are left running on their own over night.
- Leaking pipes.
- Poor drainage, for example clay have poor drainage, hence they easily create water logging conditions.

### **Reasons for draining waterlogged soils**

- To improve aeration.
- To reduce leaching.
- To prevent rotting of plant roots.
- To raise soil temperature.
- To improve seed germination.
- To destroy favourable conditions for fungal growth.
- To prevent water- loving weeds from flourishing.

### **Harmful effects of water logging**

- Leads to rotting of plant roots.
- Leads to leaching.
- Poor aeration.
- Leads to growth of water loving weeds.
- Increases fungal diseases.
- Leads to poor or low germination of seeds.

### **Methods of draining waterlogged soils**

There are two main methods, namely

- (a) Surface or open trenches.
- (b) Internal drainage/subsurface drainage.

**Open Trenches**- This refers to the use of trenches dug in fields across the slopes to drain water away to rivers and waterways etc.

### **Internal method**

The drain or mole drain pipes are laid in ditches/trenches and covered. Pipes are perforated to allow water to enter through the holes and flow away in pipes outside the fields.

### **Questions**

- 1a) What is drainage?
- b) What is water logging and what are its causes?
- 2a) State the harmful effects of water logging.
- b) What are the reasons for draining waterlogged soils?
- c) Describe how excess water is drained through mole drain pipes.

# CHAPTER 9

## IRRIGATION

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- State the advantages of trickle irrigation.
- List the problems of flood irrigation.
- Identify (4) four irrigation equipment.
- State the maintenance practices carried on pumps.

### Definition

Irrigation is the artificial application of water to crops in areas where rainfall is inadequate or the artificial application of water to crops in order to supplement the deficiency in rainfall pattern.

### Reasons for irrigating arable lands

- To supplement rain water in case of dry spells. Mid season breaks can occur at critical stages, for example, flowering in maize, thus one has to supplement moisture by irrigation.
- To extend the growing period of crops by early planting or late planting.
- To grow crops in dry season. For example, winter wheat favours low and cool temperatures in winter.
- To improve the quality of crops.

- To improve the yield of crops.
- To maximize profits. The land is used all year round, hence, farmers get more cash from a given piece of land.

### **Advantages**

- Cools the Soil
- Less risk of crop failure where irrigation is practiced
- Creates employment
- Intensifies production on a farm.
- Cash cropping is practiced in all farming regions
- Increases yields
- Prevents frost
- Leaches down undesirable salts.

### **Disadvantages**

- Causes water logging if done excessively.
- Plentiful and reliable supply of water is needed
- Requires farmer to be able to forecast prices and secure markets for his/her produce
- Needs more capital and technical knowhow.

### **Methods of irrigation**

#### 1. **Overhead/Sprinkler irrigation**

- It involves application of water through pipes, with drops slashing in the form of fine droplets like rain.

### **Advantages of overhead irrigation**

- Less labour is required
- It is not necessary to level the soil or land
- Does not destroy soil structure
- Can apply fertilizer in water and applied as foliar sprays.
- Water is measured accurately
- It is a permanent Installation.
- Helps prevent frost by covering crop leaves with water.

### **Disadvantages of overhead irrigation**

- It is an expensive method. As it involves buying of equipment and its maintenance.
- Can be affected by wind during water application.
- May cause scorching of leaves on a hot day.
- Washes away sprays from plant leaves.
- Creates favourable conditions for fungal growth.

### **Questions**

1. Define the term irrigation.
- 2(a) What are the reasons for irrigating crops?

- b) What are the advantages of irrigation?  
 3. State advantages and disadvantages of overhead irrigation.

## 2. **Flood/Surface Irrigation**

This involves covering or flooding the entire land with flowing water from canals.

### **Advantages**

- It is not affected by wind.
- No pumping is required.
- Capital cost can be less than overhead irrigation.

### **Disadvantages**

- Requires large amounts of water
- It is expensive to level the soil
- Causes poor germination due to patchy application of water
- Causes Soil erosion and leaching of plant nutrients
- leads to wastage of water
- Difficult to measure accurately the water that is applied to the crops.

## 3. **Trickle or drip irrigation**

This is the application of water to crops by means of P.V.C pipes which emit water through small holes on the pipes.

- Keeps soil around the plant wet leaving the soil between rows of crops dry.
- Water is delivered slowly through nozzles.

### **Advantages**

- Less erosion.
- Fertilizers can be dissolved and applied through this method.
- Does not wash off pesticides applied to crops.
- Does not affect soil structure.
- Requires less labour.
- Soil cultivation is restricted to a minimum.
- Method can be used on sloppy lands.
- Weed growth is limited because of limited wetted area.

### **Disadvantages**

- System is expensive
- Has a problem of clogging of filters and nozzles.
- Pipes may be damaged by rodent and bad weather.
- Trickle irrigation can be used only for crops grown in rows.

## **Sources of water for irrigation**

- Dams, Lakes
- Boreholes and wells

## **Irrigation equipment**

It comprises of:

- Pumps
- Pipes and,
- Sprinklers

(i) **Pipes**

- Some are laid underground from pumps to the fields.
- Small ones are used as vertical risings and hydrants to discharge water to crops.

(ii) **Sprinklers**

- Are fitted to risers. They break water into small water droplets and reduce drainage to crops.

(iii) **Pumps**

Suck water from the sources, for example, dams to the storage dams/tanks for use later.

**Maintenance of pumps**

- Replace worn-out valves
- Replace worn-out bolt and nuts-and screws
- Grease all moving parts
- Replace worn-out rubbers and ropes.

**Questions**

- 1a) What are the advantages of trickle irrigation?  
 b) What are the problems of flood irrigation?
- 2a) Identify (4) four irrigation equipment  
 b) State the maintenance practices carried on pumps.

# CHAPTER 10

## PRINCIPLES OF PLANT GROWTH

### Chapter Objectives

After completing a study of this chapter, you should be able to:

- Explain the difference between diffusion and translocation.
- List factors affecting the rate of transpiration in plants.
- Describe how plants absorb water and nutrients from the soil.
- Define the word imbibition.

Plants are part and parcel of life both in the human and animal kingdoms. The following factors are noted on the importance of plants:

### Importance of plants

- They are a source of plant food for animals? Man is the only living creature that is able to make their own food.
- Give fuel in the forms of wood, coal, oil and natural gas.
- Give us alcohol from sugar beet and cane.
- Get fibre to make ropes, sacking and clothing.
- Some chemicals e.g. drugs, oils, pesticides come from plants.



- They provide timber.

### Main parts of a plant

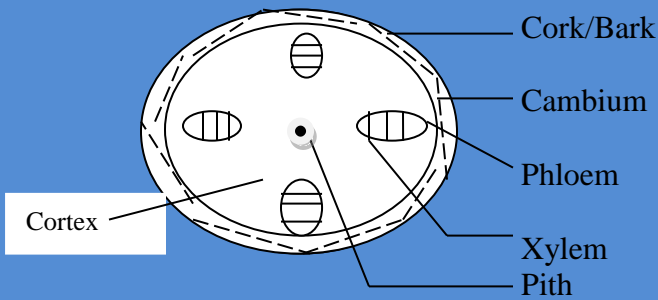
A plant consists of two main parts:

- the shoot
- the root

The shoot is made up of: stem, leaves, buds, flowers etc.

The root is made up of: tap root, lateral roots and root hairs.

### Stem structure



### Functions of stems

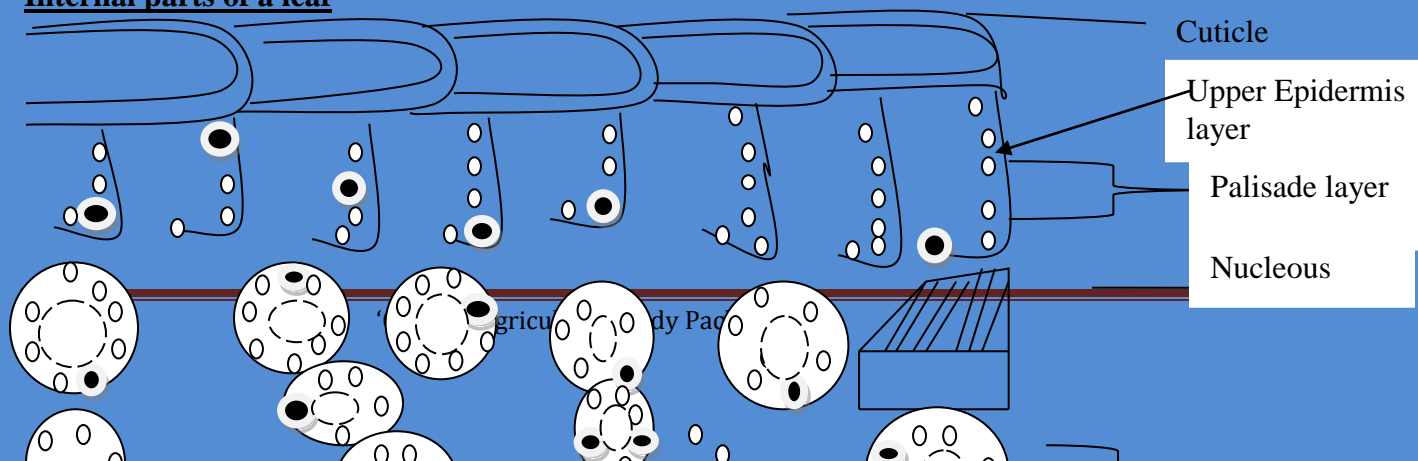
- Transport water and plant food.
- Stores plant food
- Can photosynthesize whilst still green
- Provide a wide attachment of leaves.

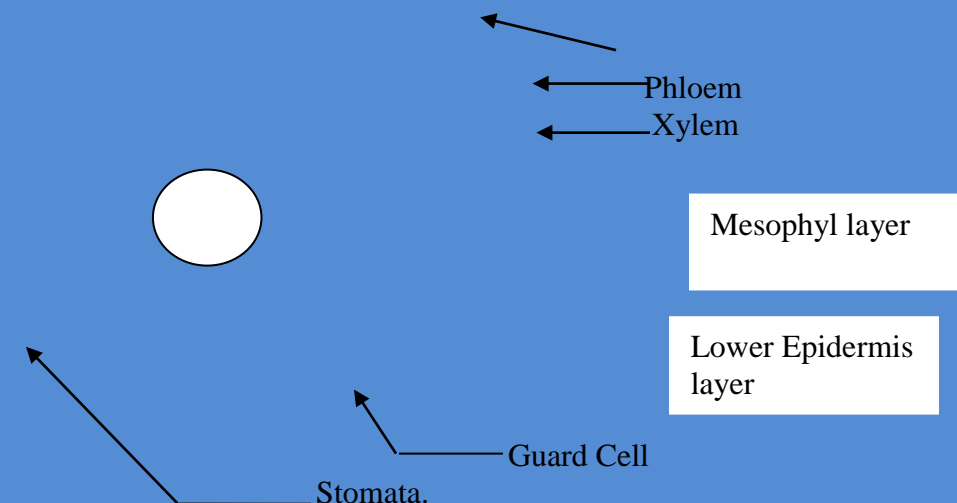
### Leaves

#### Functions

- Gaseous exchange
- Transpiration
- Is where plant carbohydrates are manufactured.
- Storage of starch temporarily
- Storage of food in some plants.
- Synthesis of proteins

### Internal parts of a leaf





### Functions of Parts

1. **Cuticle**.- Reduces rate of transpiration. It is waterproof and slippery
2. **Upper Epidermis Layer**. Maintains shape of leaf.
3. **Palisade Layer**. Receives and absorb sunlight.
  - Contains chloroplasts which receive sunlight.
4. **Chloroplast**- contain chlorophyll which absorb sunlight.
5. **Spongy Mesophyll**
  - Allows free circulation of air
  - Carries out photosynthesis
6. **Nucleous**- Controls all the activities of the Cell.
7. **Stomata**- Allows incoming and outgoing air from the leaf
8. **Guard Cell**- Control opening and closing of stomata.

### Plant processes

#### 1. **Photosynthesis**

- Is a process whereby plants manufacture their own food in the presence of sunlight plus carbon dioxide to get carbohydrates plus energy and water.



### Importance

- Helps plants manufacture their own food (carbohydrates)
- Helps remove poisonous carbon dioxide from the atmosphere.

### The leaf's adaptations to photosynthesis

- Leaves are broad and flat to provide large surface area to trap Sunlight.

- Most leaves are thin, therefore carbon dioxide diffuses through a short distance to the place of use.
- Has many stomata which allow more intake of carbon dioxide and release of oxygen
- There are many veins to supply water.
- Has more chloroplasts which contain chlorophyll which trap more sunlight.

## 2. Respiration

- Refers to the breakdown of carbohydrates during the presence of oxygen and carbon dioxide is released.



The word equation for respiration is, Carbohydrates + Oxygen  $\longrightarrow$  Carbon dioxide + Water + Energy

### Forms of respiration

#### a) Aerobic Respiration

It occurs when oxygen is available and is a source of energy for growth and other plant processes. Occurs in all living organisms.

#### b) Anaerobic Respiration

- Does not use oxygen to breakdown food.
- Little energy is released.
- Used to brew beer, to ferment sugars to alcohol.

### Differences between photosynthesis and respiration

<b>Photosynthesis</b>	<b>Respiration</b>
<ul style="list-style-type: none"> <li>▪ Occurs only in light in green cells of plants</li> <li>▪ Carbon dioxide is used and oxygen released</li> <li>▪ Light energy is built up</li> <li>▪ Plants gain weight</li> <li>▪ Chlorophyll is used</li> </ul>	<ul style="list-style-type: none"> <li>▪ Occurs all times in all living cells</li> <li>▪ Oxygen used, carbon dioxide is produced</li> <li>▪ Energy is released</li> <li>▪ Plant losses weight</li> <li>▪ Chlorophyll not used</li> </ul>

### Factors affecting Photosynthesis

The following list provides factors that affect the process of photosynthesis.

- Light intensity: The amount of light reaching leaves at a given time.
- Carbon dioxide concentration: Refers to the extent or amount of carbon dioxide in the atmosphere.
- Presence of chlorophyll: Refers to the green colour in plants which facilitates photosynthesis.

- Carbohydrates: Refers to the energy released during photosynthesis in plants.

### **Translocation**

It is the movement of manufactured plant food to the storage organs, for example, roots, stems, seeds, leaves etc.

### **Food storage organs**

- Tubers- (store most sugars)
- roots (store sugars)
- leaves
- fruits
- Seeds- (Cereals and legumes store their food in seeds)  
(Proteins, Fats/oils and vitamins-stored in seeds)

### **Importance of food storage**

Food storage helps in the movement of food from point of production to point of storage for future use.

### **Questions**

- 1a) Explain the process of photosynthesis and state its importance to plants
- 1b) Distinguish photosynthesis from respiration

## **4. Diffusion**

This is a process by which gases and liquids move from a region of their higher concentration to a region of their lower concentration till both conditions are the same.

### **Importance of diffusion**

It balances up the quantities of gases, liquids on all areas of need.

### **Transpiration**

This refers to loss of water through leaves (stomata) into the atmosphere in the vapour form.

### **Importance of transpiration**

- It removes undesirable salts from the plants.
- Enables absorption of water by the plants to occur due to osmotic potential differences, the gap created by the lost water and cool plants, that means, evaporation has a cooling effect.

### **Factors affecting transpiration**

- (i) Humidity: It is the amount of water vapour in the atmosphere. The more the humidity in the air, the more the rate of transpiration, and vice-versa.

- (ii) Wind Speed: More wind speed means a more rate of transpiration.
- (iii) Temperature: The higher the temperature, the more the rate of transpiration, and vice-versa.

### **Ways of reducing high transpiration by plants**

- Plant cuticle is thickened.
- Some plants lose their leaves in winter.
- Most stomata is found underneath the leaves.
- Some plant leaves are narrow shaped.
- Some plant leaves roll and curl when it is hot.

### 6. **Osmosis**

- It is the movement of a liquid from a region of higher concentration to a region of lower concentration through a semi- permeable membrane.

### **Importance of osmosis**

It enables plants to absorb water and nutrients from the soil.

**Imbibition:** It is the absorption of water by the seed so as to effect germination.

### **Roots**

#### **Functions**

- Absorb plant food and water from the Soil.
- Anchor plants to the soil, or supports plants from being blown away by wind.
- Act as storage organs for food.
- Used as propagative material.

#### **Questions**

1. Explain the differences between diffusion and translocation.
2. List factors affecting rate of transpiration in plants
3. How do plants reduce the rate of transpiration
4. Explain how plants absorb water and nutrients from the soil.
5. What does the word or term imbibition mean?

# CHAPTER 11

## TROPISMS

### Chapter Objectives

After completing a study of this chapter, you should be able to:

- Define the term tropisms.
- Describe the four types of tropisms.
- State the importance of each tropism in plant growth.

Tropism is the growth in response to external stimuli, for example, water, light, gravity and touch done by plants.

### Types of Tropisms

1. **Geotropism** is when plant roots grow in response to force of gravity (positive geotropism) and as a result grow downwards.

**NB:** Plant shoots grow against the force of gravity and this is called negative geotropism.

**Importance of geotropism**

-Enables plants to absorb water and nutrients from the soil.

**2. Phototropism**

It is the growth in response of plant shoots to light. This is called positive phototropism.

**Importance of phototropism**

It enables plants to absorb sunlight required for photosynthesis in leaves.

**3. Hydrotropism:** Is the growth of plant roots towards a source of water.**Importance of hydrotropism**

It enables plants to absorb water and nutrients

**4. Haptotropism**

This is the response of plant to touch, usually displayed by climbing plants. They get support and they grow tightly around the supporting plant.

**Importance of Haptotropism**

It enables climbing plants to grow upwards because they can not stand on their own.

**Questions**

1. Define the term tropisms.
  
- 2a) Describe the following types of tropisms:
  - (i) Phototropism
  - (ii) Geotropism
  - (iii) Hydrotropism
  - (iv) Haptotropism
  
- b) State the importance of each in plant growth.

# CHAPTER 12

## REPRODUCTION IN PLANTS

### Chapter objectives

After completing a study of this chapter, you should be able to:

- Explain the difference between sexual and asexual reproduction.
- Explain the difference between self and cross pollination
- Draw a diagram of a bean flower.
- State differences between insect and wind pollinated flowers.
- Distinguish Runners from Rhizomes
- Describe the three artificial ways of propagating plants.

**Reproduction** is the process of mating between female and male organisms in order to multiply.

It takes place in two ways:

- (a) Sexual reproduction
- (b) Asexual reproduction

### Sexual reproduction

- Involves the production of plants from seeds which are a result of the fusion of male and female gametes within a flower.

### Asexual or vegetative reproduction

- Refers to production of plants (new) from parent parts e.g. cuttings, suckers etc.



### Advantages of Asexual reproduction

- There is rapid increase in the number of plants.
- Offspring are identical to their parents.
- It is the only way of multiplying sterile plants, such as bananas.
- Preserves good characteristics of plants.
- Greater chances of survival due to availability of food from parent stock.

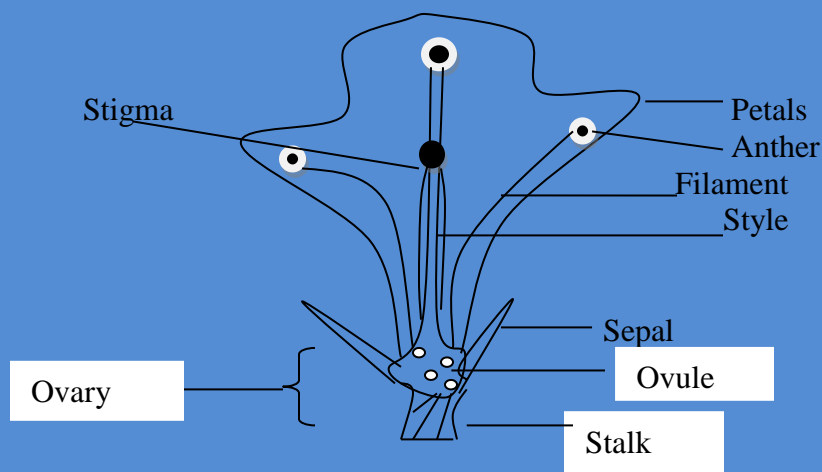
### Disadvantages

- One cannot produce new varieties vegetatively.
- Planting material is bulky, and therefore difficult to transport.
- Crops are labour intensive.
- Similar plants have a higher chance of attack by same diseases and pests.

### Advantages of sexual reproduction

- Seed is easy to handle and store.
- Some crops cannot be grown asexually e.g. maize.
- It is easy to produce many crops
- There is variation between individuals making them better adapted to the environment.

### Structure of a Bean flower



### Female Parts

#### Stigma

This receives pollen grains from the anthers.

1. **Style**-Holds the stigma and also a tube through which pollen grains move in to the ovary.
2. **Ovary**-Produces ovules for fertilizing by anthers.
3. **Ovule**- Used to fuse with pollen grains to produce a zygote.

**Male parts**

- 1, **Anthers**- Produce pollen grains
- 2 **Pollen Grains** –Fuse with ovules to produce a zygote.
3. **Filament**- Holds the anthers.

**Other parts**

- (a) Stalk-Holds the flower or attaches the flower to its mother plant.
- (b) Sepals- Protects the flower's ovary against pest damage. Encloses the flower before it blossoms
- (c) Petals- Attract insects during pollination.  
- encloses female and male parts against damage.

**Pollination**

It is the transference of pollen grains from the anthers to the stigma.

**Agents**

- Insects
- Wind
- Water

**Types of pollination****(a) Self pollination**

-This occurs when pollen grains from the same flower lands on the stigma of the same flower.

**(b) Cross Pollination**

- Occurs when pollen grains from a different flower lands on the stigma of another flower of the same family.

**Comparison of Insect and Wind pollinated flowers**

<b>Insected Pollinated E.G BEAN</b>	<b>Wind Pollinated E.G MAIZE</b>
<ul style="list-style-type: none"> <li>▪ Produce nectar to attract insects.</li> <li>▪ Are scented to attract insects</li> <li>▪ Have brightly Coloured petals to attract insects.</li> <li>▪ Anthers are inside the petals</li> <li>▪ Produce sticky or spiky pollen</li> <li>▪ Stigma is sticky to hold pollen and is enclosed within the flower</li> </ul>	<ul style="list-style-type: none"> <li>▪ No nectar</li> <li>▪ No scent</li> <li>▪ Small and dull coloured petals</li> <li>▪ Anthers hang out of petals- for wind to carry away pollen grains</li> <li>▪ Produces large quantities of small dry and light pollen grains</li> <li>▪ Stigma is feathery to increase surface area for pollen reception.</li> </ul>

## **Fertilization**

- Refers to the fusion of the male and female sex cells or gametes to form a zygote.

### **Process of Fertilization**

- Pollen grains land on the stigma, after pollination, cytoplasm in the grain grows out as a tube.
- tube grows down through the style between cells absorbing nutritive fluids from them.
- When reaching the ovary, it grows out and fertilizes the ovules through the micropyle.
- Tip of pollen tube breaks open in the ovary and female and male gamete fuse together to form a zygote.

### **Ways of dispersing seeds**

Seed dispersal is the spreading or scattering of seeds from the parents so as to avoid overcrowding of the same plants at the same place. This reduces competition for food, sunlight and air. It is done through the following mediums:

- Wind
- Water
- Animals
- Mechanical explosion

## **Questions**

- 1a) Distinguish sexual and asexual reproduction.
- b) State the advantages of asexual reproduction.

- 2a) Draw and Label the diagram of a bean flower.
- b) Distinguish self from cross pollination.

## **Asexual/Vegetative reproduction**

### **Examples of Natural reproduction in plants**

- (a) Suckers, e.g. banana trees
- (b) Bulbs, e.g. onions
- (c) Root tubers, e.g. potatoes, cassava.
- (d) **Runners**. These are stems which grow along the ground.

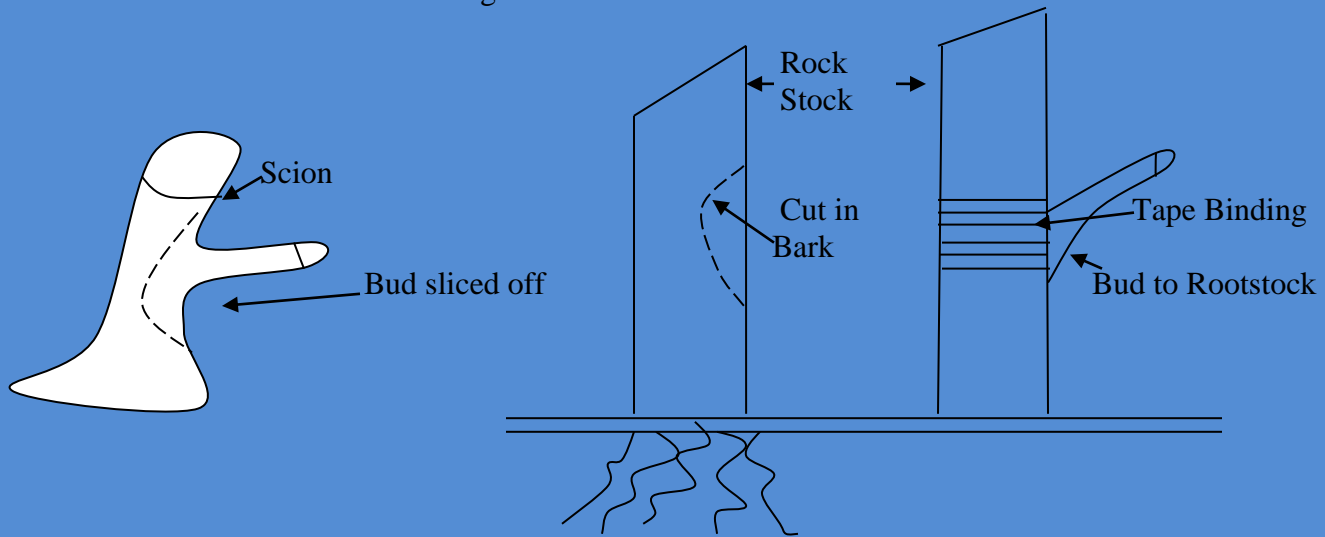
Roots and shoots develop at intervals of the stem and continue growing in different directions e.g. some grasses.

- (e) **Rhizomes**- These are thick, underground stems growing horizontally, e.g. spear grass

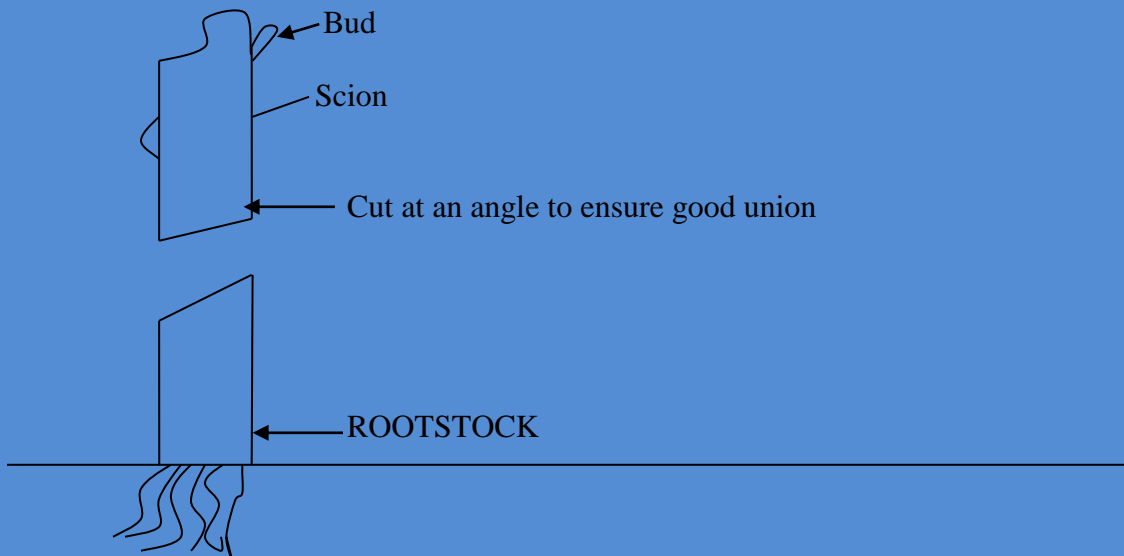
## **Artificial Propagation**

- 1 **Budding**-Is the artificial securing of a bud from one plant of the stem to the root stock of another plant of the same family
  - Bud is removed by cutting it from the stem

- A T-shaped cut is made on the rootstock and bud is carefully inserted
- Binding outline is tied round the bud to keep it in position-till joining is complete e.g. citrus trees like oranges.



2. **Grafting**-Involves the uniting of two cambium layers to get a fusion of growth giving a plant food quality of two different plants e.g. tea plants and straw berries.



3. **Ground layering**

- A branch is buried into the ground.
- Buried part is watered regularly so that roots develop
- Examples of ground layered plants-coffee, cocoa, guava, fig trees.

4. **Cuttings**

- Branches are cut (45cm long) and planted in fertile soil in order for them to develop into new plants.

An example of plants propagated through cuttings are sugarcane.

**Questions**

1. State the differences between insect and wind pollinated flowers.
2. Distinguish runners from Rhizomes
3. Describe the following artificial ways of propagating plants:
  - a) Budding
  - b) Grafting
  - c) Air layering

# CHAPTER 13

## CROP IMPROVEMENT

**Chapter objectives**

After completing a study of this chapter, you should be able to:

- Give reasons for cross breeding plants.
- Define the terms hybrid and hybrid vigour.
- Explain the differences between open pollinated and controlled pollinated plants.
- Explain the three types of hybrids.

**Genetics**

This involves the manipulation of plant genes either through controlled pollination or through genetic modification, in order to obtain higher yields, bigger produce, resistance to disease and climatic conditions.

**Reasons for Cross breeding plants**

- Improving yields.
- Improving resistance to pests and diseases.
- Improving adaptability to local environment.
- Improving quality of produce.

**Hybrid**

It is an offspring from parents carrying different genes. It can also be defined as a product of cross breeding between two different parent breeds.

**Hybrid vigour (Heterosis)**

It is obtained when different genes are crossed. It is the superiority of characteristics exhibited by off springs from the crosses. Other characteristics can be the resistance to diseases.

**Open pollinated plants**

- Are those plants whose pollination is left to nature.
- Distribution of pollen is not controlled.

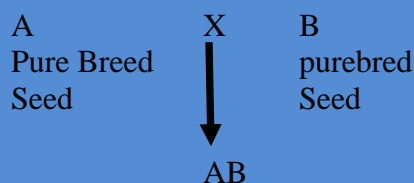
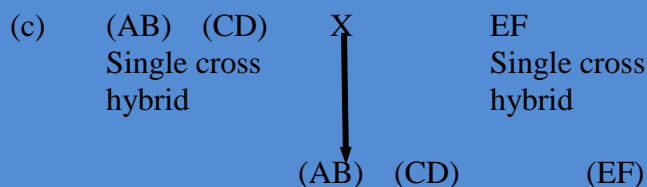
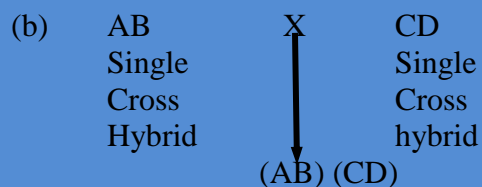
**Controlled Pollination**

- This is when the anthers of specific plants are cut off before pollen is ripe so that there will be no self pollination.

NB: In some cases the anthers or stigma are covered in bags to prevent pollination.

**Kinds of hybrids**

(a) **Single way hybrid**-Is obtained after crossing two inbred lines as below:

**Single cross hybrid****Double cross hybrid****Three Way cross hybrid**

(c) **Double Way Hybrids**. This occurs when two single crosses are used.

(d) **Three way hybrids**. This is obtained after combining single cross and an inbred line.

**Questions**

1. Give reasons for cross breeding plants.
- 2a) Explain the following genetic terms:
  - (i) Hybrid
  - (ii) Hybrid Vigour (Heterosis)
- b) Distinguish between open pollinated plants and controlled pollination.
3. Explain the following types or kinds of hybrids:
  - a) Single cross hybrid
  - b) Double cross hybrid
  - c) Three way cross hybrid

# CHAPTER 14

## LAND PREPARATION

**Chapter Objectives**

After completing a study of this chapter, you should be able to:

- Give reasons why farmers should plough before planting
- State factors considered when choosing land for tillage.
- Give reasons why stumping of trees is done by farmers.
- Explain the three forms of tillage.

Land has to be ploughed or prepared to get optimum growth conditions. In order to achieve a higher germination percentage land must be ploughed before planting so that a good crop stand is created and ultimately achieving high yields.

**Ploughing/tillage**

This refers to a planned disturbance of the soil in order to get a fine tilth. A fine tilth is a smooth well prepared seed bed achieved by discing or harrowing the piece of land.

**Reasons for land preparation**

- Land is prepared for the following reasons.
- Destroying growing plants and weeds.
- To improve aeration and water infiltration.

- To break soil pans and surface capping.
- To obtain a fine tilth.
- To incorporate manure and lime.
- Leveling the land.
- Expose pests to the sun so that they die.

### **Factors considered when choosing land for tillage**

- Topography.
- Soil Type.
- Soil fertility.
- Rainfall.
- Temperature.

### **Steps followed when preparing land**

1. **Pegging-** Done to determine the size of land. It is marked using either stones or Wooden pegs.
2. **Stumping-** Refers to the removal of trees together with their roots. Tree-Roots area is dug around using a mattock. Exposed roots are cut till the tree falls down.

### **Advantages**

- Stumps left in the field will not disturb field operations e.g. cultivation.
- Re-growth of trees will not occur.
- Diseased stumps are removed and transmission of diseases is reduced.
- Stamping ensures that machinery such as disc ploughs and disc harrows do not break down.

### 3. **Construction of mechanical conservation works**

- Storm drains and contour ridges are constructed in and outside the arable lands to conserve the soil against water erosion.

### 4. **Cultivation/Tillage**

- The land is ploughed and disced to fine tilth to improve soil - seed contact
- Manure is also incorporated during ploughing process.

### **Types of tillage**

- (a) **Primary Tillage:-** Refers to heavy duty operations such as ploughing using either a disc. plough or mouldboard plough sub-soiler, ripper.
- (b) **Secondary Tillage:** Involves light duty operations such as harrowing using a disc harrow or rolling using a roller or rotavator.



- (c) **Minimum Tillage:** Is a method of cultivation in which there is little disturbance of the soil. (There is no ploughing) There are various forms of minimum tillage and these include:
- (i) Direct planting into residues of previous crop with a hand hoe or planter.
  - (ii) Discing of land before planting.
  - (iii) Roll and plant.

#### **Advantages of tillaging**

- Little labour is required.
- Little technical-know how is required.
- Fewer tillage equipment required.
- Saves on fuel (Not expensive).

#### **Mechanized farming**

It involves the use of machinery in all aspects of the farm operation.  
Each operation uses a machine.

#### **Advantages of mechanized farming**

- Farm operations are carried out timeously, for example, winter wheat planting.
- Large areas can be worked on within a short time.
- Large areas can be used to produce crops cheaply.
- Reduction of labour.
- Machinery operations are efficient.
- Problems of pests and diseases are solved easily/quickly.
- Use of machinery makes work enjoyable on farms
- Quality of produce is improved
- High yields are obtained because large areas are planted, hence reaping the benefits of large scale production

#### **Questions**

- 1(a) Why do farmers plough their lands before planting?
- (b) State four factors considered when choosing land for tillage
- (c) What are the reasons for stumping land?
- 2(a) Explain the following farming systems:
  - (i) Primary tillage
  - (ii) Secondary tillage
  - (iii) Minimum tillage
- b) State the advantages of mechanized farming.

# CHAPTER 15

## MAIZE PRODUCTION

### Chapter objectives

After completing a study of this chapter, the learner should be able to:

- State the uses of maize.
- Describe the various factors that are found in maize farming.
- Describe the diseases that affect the maize crop.

Maize production is given a high priority in Zimbabwean agriculture. Maize is regarded as important in many regards.

### Uses

- Used as a staple food for Zimbabweans.
- To feed livestock.
- Brew beer e.g. opaque beer (maseke).
- Oil production..
- Maize stalks for manuring fields.

- Used for educational purposes.
- Generates foreign currency after exports.

### **Climatic Requirements**

- Requires rainfall ranging from 550mm 1000mm depending on varieties.
- Supplementary irrigation is required in dry areas.
- Best temperature for growth is 24°C- 30°C
- Maize is sensitive to frost.

### **Varieties**

- Are divided into short, medium and long season varieties.

<b>Short season varieties</b>	<b>LONG SEASON VARIETIES</b>
R201, P215, 5C501, 5C601 SC 401 PNR 473, SC502, ZS 240, PNR 413	SC701, ZS, 206

**NB:** Choice of varieties for planting depends on the amount of rainfall received by each region and time taken to mature.

### **Soil requirements**

- Can be grown on a wide range of soils, best being fertile and deep soils.

### **Land preparation**

- The following land preparations steps are done:
  - ploughing,
  - disc harrowing
  - rolling to a fine tilth

### **Fertilizer application**

- Apply compound D before or at ploughing period. Apply as a guide 450kg/ha (9 x 50kg bags)
- Apply 2/3 (Two-thirds) of nitrogen as topdressing 4-6 weeks after germination.
- As a guide 100kg/ha (i.e. 2 x 50kg Bags) Ammonium Nitrate.

### **Planting time**

- Done after mid-November or earlier, that is in October.
- Plant between 15 November to 25 December.

### **Spacing**

0,9m x 0,23m, for long season varieties and 0,9m x 200mm/300m short season varieties or both. (-i.e. 90cm x 23cm) (90cm x 20cm or 30cm)

### **Weed control**

Done using any of the following methods:

- Use of herbicides,
- hand pulling
- Biological method and
- cultural method.

## **Pests and pest control**

### 1. The Maize stalkborer

Burrows into plant stems and retards growth.

### **Control**

Spray with Thiodan 1% granular or with dipterex.

### 2. Armyworm

Eats maize leaves.

### **Control**

Spray with Carbaryl, Malathion, dipterex.

### **Other pests**

These include,: Aphids, cob worm, rats, weevils etc.

## **Diseases**

### 1. Maize streak virus (M.S.V)

This is caused by a virus

#### **Signs**

- Chlorosis of leaves which appear as pale green,
- Narrow broken lines parallel to the leaf veins

#### **Effects of the disease**

- Retards growth
- Plants produce very small cobs or no cobs.

#### **Prevention/control**

- Keep fields free from leaf hoppers.
- Practice crop rotation
- Spray the maize crop with Dimethoate.

#### **Other diseases**

These include:

- Fusarium kernel rot
- Giberella ear rot, and
- Diplodia ear rot.

NB: All the above are fungal diseases.

#### **Control measures**

- Spraying and killing maize stalk borer.

- Ploughing deeply.
- Burning of Stover.
- Early harvesting.

### **Harvesting methods**

Harvesting is done in two ways as follows:

- Hand harvesting.
- Mechanical (Combine harvesting)

### **Hand harvesting**

- Maize cobs are reaped into sacks and off-loaded into central points for collection
- Later, they are de-husked, shelled and dried

### **Mechanical harvesting**

- Involves cob removal mechanically, de-husking, and sometimes artificial drying and finally shelling. All these processes are done by the combine harvester.

### **Handling and storage**

- After shelling, maize grain is cleared to remove trash, weed etc, and then bagged or stored in Silos or granaries.

### **Marketing**

Maize can be bought by the G.M.B at stipulated prices or private buyers.

### **Questions**

- 1a) State the uses of maize.
- b) Discuss maize production under the following headings:
  - i) Climatic and soil requirements.
  - ii) Time and method of planting.
  - iii) Harvesting procedures.
  - iv) Storage.
2. Discuss maize streak virus under the following headings:
  - (i) Cause.
  - (ii) Signs of attack.
  - (iii) Control method.

# CHAPTER 16

## CROP PROTECTION

### Chapter objectives

After completing a study of this chapter, you should be able to:

- Explain the terms complete metamorphosis and incomplete metamorphosis.
- Describe the term cultural pest method.
- Identify the four types of pests.
- Describe the three modes of pesticide attacks.
- Give the differences between “selective and non-selective herbicides.
- Describe the problems affecting tomatoes and ground nuts.
- List the five natural problems on crops.
- List the five basic precautions when using chemicals.

This involves protecting crops from pests, diseases, weeds and any other undesirable factors which may reduce yield. It is important that we produce crops from all of the above mentioned dangers because our efforts, time and money would go to waste if this is not done.

### Economic importance of crop protection

- Some pests are used as relish e.g locusts, crickets and mice

- Underground pests helps aerating the soil
- Form humus after death.

### **Lifecycle of insects**

- It is grouped into two lifecycles.

#### (a) **Complete Metamorphosis**

It is when an insect undergoes four stages in growth, that is, the egg, larva, pupa and adult.

#### (b) **Incomplete metamorphosis**- Insects undergo three stages in their growth, that is, the egg, nymph, and adult.

### **Pests**

This refers to insects which damage crop plants e.g. aphids, bagrada bugs etc.

### **Classification of pests**

#### (a) **Biting and chewing pests**

- These chew different parts of plants e.g. leaves, stems, and flowers e.g. locusts, termites leaf miners, budworms etc.

#### (b) **Sucking pests**. They Suck sap from plants resulting in permanent wilting of plants e.g. aphids, spider mites, mealy bugs, fruit flies.

#### (c) **Boring pests**. They Burrow into stems of plants or seeds e.g. stalkborer weevils etc.

#### (d) **Nematodes**. They Tunnel into roots or tubers thus causing swelling of roots. E.g nematodes, eelworms.

### **Other pests**

These include: Rodents, rats, Mice, rabbits etc are frequent pests of field crops. They dig up and eat planted seed, tubers before harvesting and after harvesting.

**Birds**-They are troublesome in rice, millet fields and other cereals e.g. quelea birds.

### **Damage caused by pests/harmful effects**

- Weevils destroy seeds.
- They burrow into fruits and stems e.g. fruit flies and stalk borer.
- Cutworms cut stems of plants causing lodging.
- Cotton strainers lower the cotton lint grade.
- Cause severe defoliation e.g. grass-hoppers or armyworm.

### **Scouting**

It is the random checking for the presence of pests in crop lands. Plants are physically checked by random sampling.

**Scouting methods**

- (i) Zigzag method
- (ii) Diagonal method
- (iii) Stepped traverse method

**Control methods****1. Biological method**

- Involves use of beneficial insects e.g. predators e.g. cotton predators which prey on cotton stainers.
- Introduces fungi/viruses which attack pests.

**Advantages of the biological method**

The method is not expensive.

**Disadvantages of the biological method**

It is not effective.

**2. Cultural Method**

- Involves practices such as:
  - (a) Planting resistant cultivars.
  - (b) Early planting.
  - (c) Crop rotation practice.
  - (d) Destruction of crop residues.
  - (e) Weed removal.
  - (f) Planting dressed Seed/Certified Seed.

**Advantages**

It is effective if correctly done

**Disadvantaged**

Not effective if incorrectly implemented.

**3. Chemical Method**

- Involves use of pesticides to kill pests.

**Advantages**

- It is a very effective method. (The best method).

**Disadvantages**

- Is very expensive
- Farm chemicals are dangerous to the user, farm animals and crops.
- Kills beneficial organisms



### **Integrated Pest Management**

- Involves controlling or killing of pests using a combined or combination of all control methods. All the control methods are used simultaneously hence improving effectiveness.

### **Ways of applying pesticides**

These include:

- Spraying
- Dusting
- Fumigation
- Baiting
- Seed dressing

### **Mode of Attach of pesticides**

- (a) **Systemic Poisoning**
  - Kills sucking pests e.g aphids. Pesticides applied on plants get absorbed into the plant system (sap), poisoning the sap.
- (b) **Stomach poisoning.** Poison pests after being digested. These kill pests which bite and chew plants.
- (c) **Contact Poisoning.** Kills pests when they get into contact with sprayed plant parts e.g. EDB.

### **Pesticide toxicity**

-Manufacturers' chemicals are labelled with triangles of different colours. The colours indicate the toxicity of each chemical.

1. **Green triangle**
  - Contain the least poisoning pesticide or chemical.
2. **Amber-Triangle**
  - Chemical contained is poisonous. Handle with care
3. **Red Triangle**
  - Chemical contained is very poisonous. Handle with care.
4. **Purple- Triangle**
  - Chemical contained is extremely dangerous. Handle with extreme care.

### **Questions**

1. Explain the differences between complete metamorphosis and incomplete metamorphosis.
2. Describe with examples the following classes of pests:
  - (a) Biting and chewing pests.

- (b) Sucking pests.
  - (c) Boring pests.
  - (d) Nematodes.
3. Describe the term cultural pest control method and give examples to support your description.
  4. What is meant by integrated pest management control?
  5. Explain the differences amongst the following mode of pesticide attack:
    - (i) Systemic method.
    - (ii) Contact method.
    - (iii) Stomach method.

### **Weeds**

These are plants which grow where they are not wanted by man.

#### **Damage caused by weeds**

- They harbour pests and diseases.
- Compete with crop plants for water, sunlight, and nutrient and space.
- Some weeds are poisonous to domestic animals.
- Some weeds are parasitic e.g. witchweeds.

#### **Lifecycle of weeds or growth habits**

- (i) **Annual weeds.** They Complete their lifecycle in one season.
- (ii) **Biennials.** They Complete their lifecycle in two seasons.
- (iii) **Perennials.** They take several years to complete their lifecycle e.g. bitter apple, thorn apple, couch grass.

#### **Methods of weed control**

- (a) **Hand pulling**
  - This involves pulling up weeds by hands.

#### **Advantages**

It is most effective when weeds are small and in small lands.

#### **Disadvantages**

- It is a slow method.
- Not effective when weeds are large.
- Only effective on wet soils.

- (b) **Mechanical method**

It involves use of hoes, tractor cultivation and ox-drawn-cultivators etc.

#### **Advantages of the Mechanical Method**

- Effective for weeds between rows.

- Is faster and cover large hectares of land.

#### **Disadvantages of the Mechanical Method**

- Require an ideal soil condition e.g. wet soils
- Damage crop roots
- Mounted equipment tends to be very expensive.

#### **(c) Chemical Method**

This involves use of herbicides to kill weeds.

#### **Advantages of the mechanical methods**

- It is not time consuming.
- Saves labour.
- It is fast and cover large lands.
- No physical damage to crops, if correctly mixed and applied.

#### **Disadvantages**

- May damage crops, if not correctly mixed
- Herbicides are expensive to buy
- Have residual effects which may inhibit growth of other crops
- Results in death of beneficial insects, animals and birds. After grazing/consuming)

#### **Types of Herbicides**

1. **Selective Herbicides**-Kill certain types of weeds e.g. all grasses.
2. **Non-selective Herbicides**

They kill all green plants on land e.g. paraquati, sodium chlorate, gramaxone etc.

#### **c) Biological Method**

It involves use of beneficial insects introduced to crops so that they feed on weeds.

#### **Advantages**

It is not expensive

#### **(d) Cultural Method**

This involves the use of field practices like:

- (i) Growing crops in a rotation.
- (ii) Early planting.
- (iii) Correct spacing.
- (iv) Correct fertilization.
- (v) Seed dressings.
- (vi) Practicing strict hygiene.

**Crop Diseases**

(a) **Bacterial Wilt (of Tomatoes)** is caused by bacteria.

**Signs.**

Plants wilt completely.

**Control Methods**

- Practice crop rotation
- Drain water logged soils
- Practice strict hygiene

(b) **Damping off** of seedlings is caused by fungi

**Signs**

- Seedlings Lodge due to rooting of stems a few centimeters below ground level

**Control**

- Spray with fungicides containing copper.
- Plant Certified Seed.

(c) **Rosette of groundnuts** is caused by a virus

**Signs**

- Stunted growth of groundnuts.
- Patches appear on leaves.

**Control**

- Kill aphids and leaf hoppers.
- Plant resistant cultivars.

**General causes of plant diseases**

- Unhygienic conditions e.g. weed infested lands.
- Damaged or diseased plant residues
- Unsuitable soil temperature (waterlogged Soils)
- Unsuitable Soil pH
- Planting Season

**Types of crop diseases**

- (i) Pathological diseases
- (ii) Nutritional diseases

**General control ways on crops**

- Plant clean propagative material.
- Use certified seed.

- Remove weeds all times.
- Practice crop rotation all times.
- Treat planting material with fungicides.

### **Other causes of crop damage**

These include:

- Too much rainfall.
- Drought.
- Frost.
- Hail.
- Too high temperature.
- Strong wind.
- Water logging.
- Capping and Soil pans.

#### 1. **Too much rainfall**

##### **Effects**

- Causes soil erosion.
- Causes water logging.
- Poor water infiltration.
- Causes capping on clay soils.
- Causes leaching

##### **Solutions**

- Construct ridges.
- Plough across slopes.
- Grow cover crops.

#### 2. **Hail**

##### **Effects**

- Destroy crop leaves.
- Increase runoff resulting in sheet erosion.

##### **Solution**

- Take up a hail insurance policy in order to get compensated in case of damage.

#### 3. **Too High Temperature**

##### **Effects**

- Increases rate of transpiration.
- Causes temporary and permanent wilting of plants.

##### **Solutions**

- Mulch the arable land
- Irrigate the land regularly

- Grow cover crops

#### 4. **Frost** **Effects**

- Causes bursting of plant cells resulting in permanent wilting.

#### **Solutions-Choice** of site (to be good)

- Plant resistant cultivars
- Construct frost barriers above crops
- Create artificial winds
- Make some fire around the field or garden to raise temperatures.

#### 5. **Strong wind**

##### **Effects.**

- Causes lodging of plants.
- Speeds up rate of transpirations
- Causes sheet erosion

##### **Solution**

- Cover crops.
- Plant trees on bare lands.

#### 6. **Water logging**

##### **Effects**

- Causes leaching of nutrients.
- Causes poor aeration for microbial activity and roots welfare.
- Promotes weed control.

##### **Solutions**

- Drain water logged soils.
- Improve soil structure.

#### 7. **Capping**

##### **Effects**

- Suppresses the emergence of seedlings.

##### **Solutions**

- Apply manure to improve soil structure
- Avoid over irrigation

#### 8. **Soil Pans**

##### **Effects**

- Causes poor root elongation

##### **Solution**

- Vary ploughing depth

### **Methods of weed dispersal**

- By-wind
- Water
- Animals
- Physical explosion

### **Classification of Pesticides/Insecticides**

1. **Insecticides** kill pests or insects.
2. **Acaricides** kill pests belonging to the Arachnida family e.g. ticks, red spider mites, mealy bugs.
3. **Nematicides** kill pests belonging to the animal kingdom e.g. nematode, earthworm and roundworm.
4. **Rodenticides** kill pests belonging to the animal kingdom belonging to the class mammalia, e.g. rats.
5. **Fungicides** kill fungi using fungicides e.g. dithane M45, Zineb,
6. **Bactericides** control bacteria

### **Safety precautions when using farm chemicals**

- Read and understand manufacturer's instructions before applying farm chemicals.
- Mix the chemicals according to instructions.
- Be in the opposite direction of the wind when spraying.
- Wash the body after spraying.
- Don't use empty pesticide or herbicide containers as food containers.
- Wear protective clothing, for example, gloves, gumboots and respirators.
- Keep farm chemicals under lock and key.
- Never blow nozzles of chemical containers with your mouth.
- Do not sniff chemicals.

### **Question**

1a) Distinguish selective from non-selective herbicides

b) Discuss bacterial wilt of tomatoes or Rosette of groundnuts under the following headings:

- (i) Cause.
- (ii) Signs of attack.
- (iii) Prevention.

2a) State the harmful effects and suggest solutions to the following natural problems to crops:

- (i) Drought.
- (ii) Water logging.
- (iii) Soil pan and capping
- (iv) Frost.
- (v) Strong wind.

b) List five safety precautions followed when using farm chemicals.

# CHAPTER 17

## FORESTRY

### **Chapter objectives**

After completing a study of this chapter, you should be able to:

- Define the term deforestation.
- Give the causes of deforestation.
- Give the difference between exotic and indigenous trees.
- Describe how trees are harvested.
- Define the term agro-forestry.
- Give the advantages of agro-forestry.

This refers to the growing, management and use of trees.



## **Deforestation**

It is the destruction of wood vegetation by randomly cutting them down or burning.

### **Causes**

- Land clearing for road construction.
- Collection of wood for fuel.
- Construction of houses.
- Population pressure.

### **Effects of deforestation**

- Causes erosion due to lack of land cover.
- Degraded land.
- 
- Increased surface runoff.
- Reduced yield and animal production.

### **Solution**

- Plant trees.
- Preserving remaining forests.
- Rural electrification to reduce deforestation for firewood.
- Use gas or electric stoves.

### **Types of trees**

1. **Indigenous Hardwoods.** These provide hard timber e.g. Mukwa, Zimbabwean teak, Mahogany.
2. **Indigenous** softwoods trees that originally grow in Zimbabwe e.g. Mahogany which produce soft timber.

(a) **Exotic Trees.** These are trees from other countries e.g. gum trees, pines and, paper trees etc.

### **Advantages of commercially produced timber.**

- Produce straight timber.
- Grows fast.

### **Disadvantages**

- Does not tolerate drought, pests and disease attack.

### **Advantages of Indigenous trees**

- Tolerate drought, pests and diseases.

### **Disadvantages**

- Produce timber which is not straight.
- Take a long time to mature.

### **Site selection factors**

- Water supply.
- Well drained.
- Fertile soil.

### **Sowing seeds**

- Fill pockets of polythene sleeves with fertile soil.
- Drill seed evenly in trenches.
- Mulch the sleeves.
- Cover seed with sand/loose manure.
- Water the planted seed.

### **Care for seedlings**

- Remove weeds.
- Water the Seedlings.
- Control diseases.
- Apply manure/fertilizers.

### **Transplanting**

- Done in November- December, during the rain Season.

### **Spacing**

- 2,5 X 2,5m apart.

### **Protection against fire**

- Construct fireguards and should be 4-5m wide.

### **Harvesting**

- Should be done late- October to early November after maturity.
- Cut trees 10cm above ground level using an axe or bow saw at angle of 45°.

### **Coppicing**

- Are shoots which emerge after harvesting trees. These are left to grow in large numbers and after 18-24 months, some shoots are removed and only two shoots are left growing side by side-till maturity.

### **Agro-forestry**

- Refers to Land- use systems in which trees or shrubs are grown in association with agricultural crops, pastures, or livestock and in which there are interactions between trees and other components.

### **Advantages**

- The land is fully utilized.
- Labour is always in use all the times.
- Livestock gain food from crops and tree leaves.
- Crops gain manure from the animals kept.

- Prevent erosion as the land has a cover.

### **Disadvantages**

- Trees harbour pests such as birds and insects harmful to crops.
- Presence of trees makes ploughing or cultivation operations difficult.
- Technical know-how is required.

### **Questions**

- 1a) What are the causes deforestation?
- b) What are the advantages of exotic trees?
  
- 2a) What are the differences between indigenous and exotic trees?
- b) Describe how trees are harvested?
  
- 3(a) Explain the term agro-forestry
- (b) What are the advantages of agroforestry.

# **CHAPTER 18**

## **LEGUME CROP-GROUNDNUTS**

### **Chapter Objectives**

After completing a study of this chapter, you should be able to;

- Define what legumes are.
- Give examples of legume crops.
- Describe the steps that are gone through in the production of legume crops.

There are mainly seed crops that are used to produce oils and fats. Their main uses are given below.

### **Users**

- Extraction of cooking oil.
- Manufactured margarine.

- Soap.
- manufacture groundnut cake.
- livestock hay.
- confectionary purposes e.g sweets.

### **Varieties**

<b>SHORT SEASON VARIETIES</b>	<b>MEDIUM SEASON VARIETIES</b>	<b>LONG SEASON VARIETIES</b>
Plover Falcon Valencia R1 Valencia R2 Natal common	Shallow	Flamingo Heron Egret Makhulu Red

### **Soil requirements**

- Groundnuts grow well on fertile soils, well drained and deep soils. e.g. sand loam, clay, loam soils.

### **Climatic Requirements**

- Prefer warm temperature.
- Rainfall required ranges between 725-865mm per annum.
- Don't tolerate frost.

### **Land preparation**

- Land is ploughed, rolled, and disced to a time tilth.
- Ridges are constructed on heavier soils for easy lifting during harvesting.

### **Planting time**

- Some cultivars are planted in September or early October for late (Long season cultivars and October or November for early ones)

### **Planting methods**

Can be planted by either hands or groundnut planters.

### **Spacing**

- 450mm apart x 100mm-150mm for long season varieties.
- 450mm apart x 50-75mm- short season varieties.

### **Fertilization of legume crops**

- Apply compound S after ploughing and harrow it in.
- Top-dress when symptoms of deficiency have been shown.
- Apply gypsum for pod formation.

**Weed Control**

- Can be done by hand pulling, use of herbicides, mechanically or culturally.

**Harvesting**

- Done when groundnut plants are mature.

**Signs of Maturity**

- Yellowing of leaves.
- Appearance of block markings on the inside of pods.
- Pods open easily, when rubbed and pressed between the fingers.
- Kernels rattle inside pods.
- Kernels show colour, as to which is the true type e.g. Makhulu red has red kernels.

**Harvesting Procedures**

It is done in two ways:

- (a) Convectional method
- (b) Mechanical method

<b>Mechanical method</b>	<b>Conventional method</b>
Loosening	Loosening
Lifting	Lifting
Wilting	Wilting
Picking	Coking
Artificial drying	Pricking

**Shelling** is done by using groundnut shellers and winnowers.

**Preparation for marketing**

- Cleaning, grading and packing into 50kg bags and weighed before being sown with twine.

**Storage**

- Best stored in pod form to give protection against pest e.g. weevils in bags or silos.

**Marketing**

- Groundnuts are marketed at GMB.
- Moisture content should be 6,5- 8%

**Pests****(a) Termites**

- Feed on roots, stems and pods.

**Control**-Fumigate with EDB or methyl dibromide.

- (b) **Aphids**  
**Effects.** They suck sap from leaves.  
**Control.** Spray with monocrotophos, diazinon, Malathion

### **Diseases**

- (a) **Rosette** is caused by a virus.

#### **Signs**

- Chlorosis of leaflets.
- Poor elongation of pods.

#### **Control-**

- Spray aphids.
- Use dressed Seeds.
- Plant early in the seasons.

### **Other diseases**

- Pod rot
- Cercospora leaf spot.

### **Questions**

1. For a named legume crop, discuss it under the following headings:
  - (a) Name of crop
  - (b) Seedbed preparation
  - (c) Signs of maturity
  - (e) Harvesting
  - (f) Uses of groundnuts

# **CHAPTER 19**

## **POTATO PRODUCTION**

### **(TUBER CROP) IRISH POTATOES**

#### **Chapter objectives**

After completing a study of this chapter, you should be able to:

- Define what tubers are.
- Describe the climatic requirements for tubers to do well.
- Describe the preparation of land for tuber production.
- Describe the harvesting of tubers.
- Give the diseases and their treatment, that affect tubers/.

Potatoes are an exotic crop in Zimbabwe. It is a tuber crop of the family of sweet potatoes and Madumbe. Madumbe are found in Manicaland. They look the same as Mbambaira/Imbambayila. Potatoes are thought to have come from Ireland. Hence they are an exotic crop.

### **Uses**

- Used for human consumption as a source of carbohydrates.

### **Varieties**

- Montclare
- Inyanga
- Emerald
- BPI
- Amethyst

### **Climatic requirements**

- Require moist conditions.
- Can be damaged by drought.
- Temperature range is between 15-20°C.

### **Soil requirements**

- Prefer fertile, well drained soils.
- Require soils whose pH ranges between 5, 0 -5, 5.
- Avoid heavy clay soils which causes disfigured potato seed/tubers.

### **Land preparation**

- Ploughing, discing and harrowing is done.
- Ridges are constructed to plant potato seed.

### **Planting time**

- Some cultivars are planted in February-April some in between July-August or November.

### **Planting methods**

- Can be either be planted by hand or planters.

### **Planting material**

- Plant tubers with at least two eyes.

### **Spacing**

- 300mm x 900mm

### **Earthing**

- Done to maintain shape of ridges, give tubers enough room for tuber initiation, protect tubers from tuber moths and sunlight and causes greening of tubers.

### **Fertilization**

- Apply compound S. which contain boron for tuber initiation.

**Harvesting**

- Done after potatoes are mature, usually four months after transplanting.

**Signs of maturity**

- Leaves of plants determine maturity.
- Size of tubers determine maturity as well.

**Harvesting procedures**

- Loosen the soil using a garden fork or digger shaker.
- Lifting or picking follows after.

**Preparation for marketing**

- Cleaning to remove soil.
- Grading according to size, mass etc.

**Storage**

- Tubes are stored in dark rooms whose temperature is 3-5°C and free from moisture.

**Pests****(a) Potato tuber moth**

- Suck sap from potatoes tubers and leaves.

**Control**

- Earth potatoes, that is, putting soil on potatoes.
- Spray with monocrotophos 40%.

**(b) Nematodes**

- They cause swellings of tubers and/rootknot.

**Control**

- Fumigate the soil with EDB, methyl dibromide.
- Practice crop rotation.
- Spray with nemagon.

**Diseases**

- (a) **Late blight** is caused by Fungi.

**Signs**

- Appearance of water soaked areas on the leaves which gradually turn brown.
- Leaves shrivel and eventually die.

**Control**

- Spray with fungicides e.g. maneb, zineb and Dethane M45 or copper Oxychloride.



- (b) **Early blight** is caused by fungi.

### **Signs**

Brown spots on the leaves of infected plants.

### **Questions**

1. For a named tuber crop, describe it under the following headings:
  - (a) Climatic and soil requirements
  - (b) Seedbed preparation
  - (c) Method of harvesting
  - (d) Preparation for marketing
  
2. Describe the field practices or operations carried out between planting and harvesting.

# **CHAPTER 20**

## **SUGAR PRODUCTION**

### **Chapter Objectives**

After completing a study of this chapter, you should be able to:

- Determine the uses of sugar cane.
- Describe the planting of Sugar cane.
- Describe the climatic requirements for sugar cane production.
- Identify types of sugar cane and diseases.
- Describe how Sugar cane is harvested.

The growing of sugarcane is a commercial activity which brings a lot of foreign currency into the country. The largest activities of sugar cane farming are done in Chiredzi and Hippo Valley. Sugar cane has several uses.

### Uses

- For blending ethanol
- For brewing beer.
- For making confectionaries e.g. sweets.
- For molasses for livestock feed.
- Used as a sticker for inoculants.
- Used as a bagasse for inoculating beans.

### Soil requirements

- Optimum temperature vary from 25-28°C
- Favours rainfall of about 1000mm- 1250mm per year.
- Requires dry periods during maturity to allow accumulation of sucrose in the cane tissues.

### Land preparation

- Ploughing, disc harrowing, rolling, and rotation of soil to give a fine tilth is done.
- Construct ridges.

### Varieties

- Nco 376
- N52
- N219

### Planting material

- Use seed cuttings of a length of 25-30cm and each to have 2-3 buds.

### Spacing

- 1- 1,5m x 250mm in row spacing.

### Planting time

-Done during the rain seasons or in summer

### Planting methods

- Done by hands

### Pests

- (a) Migratory locusts  
- They eat foliage of sugar cane plants.

**Control**

-Spray with carbaryl

- b) **Termites**
- They eat stems, roots.

**Control**

- Use dieldrin or aldrin or phostoxi tablets

**Harvesting**

- Mature cane is burnt to destroy dry leaves, chase wild animals, reduce irritation to harvesters.
- Stalks are cut down at ground level using sharp knives.

**Questions**

- 1a) What are the uses of sugar cane?
- b) Describe how and when sugar cane is planted.
- 2a) Describe the climatic requirements for sugar cane.
- b) Describe how sugar cane is harvested.
- c) Identify any two pests of sugar cane.

# **CHAPTER 21**

## **TILLAGE IMPLEMENTS**

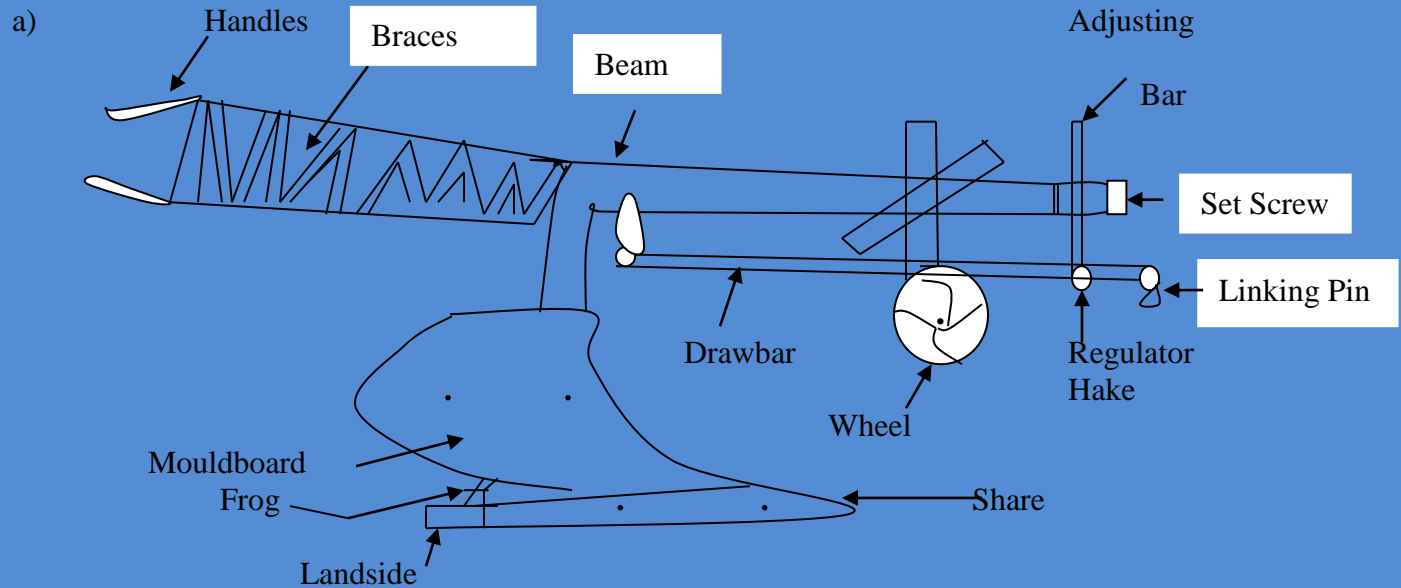
**Chapter Objectives**

After completing a study of this chapter, you should be able to;

- Define what tillage implements are.
- Draw diagrams of tillage implements and label them.
- Explain the functions of various implements.

Tillage implements are all the mechanical and non-mechanical implements that are used to make tillage a success.

1. **Plough** (Mould board plough)
  - Used to till land.



### Functions of parts of a plough

1. Share. Cuts the furrow slice.
2. Lanside. Keep the plough in contact with the cut edge of furrow.
3. Mouldboard. turns the furrow slice over
4. Hitch assembly. Used to adjust depth of plough and width of cut.
5. Handle bars. Control the plough.
6. Wheel. Used to adjust plough depth.
7. Beam. Is where all parts of a plough are attached.

### Depth adjustments

- a) Depth
  - For shallow depth-lower the depth rod and tighten the set screw.
  - For a deeper cut- raise the depth rod and tighten the set screw
- b) Width of cut
  - For a wider cut, move the depth rod to the left hand side.
  - For a narrow cut, move the depth rod to the right hand side.

### Maintenance

- Replace worn out parts
- Tighten bolts and nuts
- Clean the plough after use.

## **Cultivators**

### **Use of cultivators**

- To remove weeds and to loosen the soil to improve water infiltration and seed bed preparation.

### **Parts**

- Share, tines, spikes, chisel, sweep.

### **Maintenance**

- Clean the cultivator after use.
- Tighten bolts and nuts frequently grease all moving parts.

## 2. **Harrows**

- Used for destroying clods to get a fine tilth.

### **Maintenance of Harrows**

- Grease discs bearings.
- Clean harrows.
- Tighten bolts and nuts.
- Replace worn out parts.

## **Planting implements**

### 1. **Planters**

- Used for planting seed.
- Can be used to apply fertilizer.

### **Parts**

- Discs- parts or shares that penetrate soil
- Seed box-a box where seed is put or placed
- Chute-is the opening through which seed or fertilizer falls through.

### **Maintenance of planters**

- Grease all moving parts
- Tighten bolts and nuts
- Check bearings and replace worn out ones

### **Ridger**

- Used to build up ridges.
- Used to earth potatoes, groundnuts etc.

### **Adjustment of a Ridger**

- Width of rows between ridges can be adjusted by moving the disc mounting on the tool bar, setting them closer together or further apart.

### **Questions**

- 1 (a) draw and label a diagram of a moldboard plough
  - (b) Describe how a plough is adjusted for (i) depth  
(ii) Wider or Narrow cut
  - (c) What are the functions of the following implements:
    - (i) Planter
    - (ii) Ridger
    - (iii) Harrow
- 2) How are they maintained.

# **CHAPTER 22**

## **DECORATIVE HORTICULTURE**

### **Chapter Objectives**

After completing a study of this chapter, you should be able to:

- Define what decorative horticulture is.
- Describe specific hedge plants.
- Give details of land preparation, planting, maintenance and marketing.

This refers to the production of flowers and other plants artifacts, which are used to beautify places.

### **Importance**

- Houses and homestead are beautified.
- Flowers improve flavour of food.
- Flowers are used to mark special occasions like weddings.
- Hedges are used to screen unsightly areas like cliffs.
- Hedges act as barriers or boundaries.
- Lawns act as carpet in recreational places and gardens.
- Lawns help improve the appearance of some areas.
- Lawns control erosion in areas they cover.

### **Hedges and shrubs**

#### **Bougainvillea**

- Are growth as shrubs or hedges around homesteads.

#### **Climatic requirements**

- Need fairly large amounts of watering for establishment. Do best in fairly dry conditions (warm conditions).

#### **Soil requirements**

- Do best in fairly deep and well drained soils.

#### **Varieties**

- Grabra.
- Superred.
- Mrs Eva.
- SirRoy.
- Moonlight.

#### **Preparation and planting**

- Trenches are dug (- 25- 40cm deep).
- Apply compost fertilizer is applied.

#### **Planting**

- Plant cutting that have 3-4 buds, should be at least 45cm long.
- First the cuttings are put in pockets for rooting and shooting.

#### **Maintenance**

- Watering has to be done.
- Apply manure during the first year.
- Prune them between December and march.

#### **Questions**

1. For a named hedge plant, describe or discuss it under the following headings:
  - (a) Soil and climatic requirements
  - (b) Land preparation
  - (c) Planting

- (d) Maintenance

## ***CHAPTER 23***

### **LAWN MANAGEMENT**

#### **Chapter Objectives**

After completing a study of this study, you should be able to;

- Define what lawn management is.
- Describe the production process of lawn projects.

#### **A Lawn**

Lawn management is ground covered by a fine grass which is kept closely cut or mowed around a building or as part of a garden or park.



### **Factors affecting choice of lawn grass**

- Aesthetic value.
- Availability of water.
- Easy of establishment.
- Resistance to wear by foot action.
- Fineness.

### **Types of lawn grasses**

- Couch grass.
- Australian evergreen.
- Beira green.

### **Land preparation**

- Clearing of land.
- Ploughing.
- Fertilizer application.
- Leveling of soil.
- Rolling of soil to a fine tilth.

### **Planting time**

- Plant in August to September because the weather will be warming up.

### **Planting methods can be done through:**

- (a) Furrow planting.
- (b) Dibble planting.

### **Watering**

- Water twice a week in summer on light soils.
- Water once per week on heavier soils.

### **Weed control**

- Can be done by hand pulling of weeds or kill them through use of herbicides.

### **Maintenance of lawns**

Done through:

- Mowing the lawn grass
- Spiking
- Fertilizer application
- Edging-done to demarcate borders of lawns, paths.
- Disease control.

### **Questions**

1. For a named lawn grass describe its production under the following headings
  - (a) Land preparation
  - (b) Time of planting
  - (c) Maintenance

## **CHAPTER 24**

### **BEDDING FLOWERS**

#### **Chapter Objectives**

After completing a study of this chapter, you should be able to:

- Define what bedding flowers are all about.
- Describe the processes of preparations for bedding flowers.

#### **BEDDING FLOWERS**

- Are flowers planted in beds

#### **Dwarf marigold**

#### **Propagation**

- Is propagated from seed and seedlings.
- These are planted and raised in seedling boxes or nursery beds.

### **Sowing**

#### **Nursery beds preparation**

- Digging is done using a hand hoe to loosen soil.
- Clods are destroyed to fine tilth.
- Manure is applied and incorporated into soil.
- Seeds are sown in seed drills 5-8 cm apart and covered lightly with soil.
- Water planted seed.
- Shade the planted nursery bed 15-20cm above ground.

#### **Sowing in Situ**

- Dwarf marigold seed can be sown- in-situ at a spacing recommended and thinned out when 5-6 leaves have developed.

#### **Pricking out of flowers**

- Done to seedlings after the third leaf, develops into seedling boxes.
- Done to increase growing space.

#### **Hardening**

- Seedlings are exposed to a dry condition so that they get used to the permanent bed condition after transplanting.

#### **Flower Bed Preparation**

- Digging to a depth of 30-40cm-using a hoe.
- Clods broken down- to a fine tilth.
- Apply manure and incorporate it.
- Construct ridges and level them.
- Watering is done.

#### **Transplanting**

- Done when seedlings are 5-6 leaves.
- Transplanted at a spacing of 25-30cm and in-row spacing 10-15m.
- Mark planting holes and transplant in a cool day.
- Water transplants.
- Shade transplants.

#### **Fertilizer application**

- Apply compound D at 20-30g/m<sup>2</sup> and incorporated into the soil.
- Also top-dress the flowers with Ammonium nitrate four weeks after transplanting.

#### **Watering**

- Beds and seedling boxes should be watered regularly from planting till maturity
- Water seedlings once or twice a week till flowering.

**Weed control**

- Hand weeding or remove them using a garden trowel or hand fork.

**Questions**

1. For a named bedding flower, discuss it under the following headings:
  - (a) Propagation
  - (b) Sowing
  - (c) Seedbed preparation
  - (d) Transplanting
  - (e) Fertilization.

# **CHAPTER 25**

## **ANIMAL HUSBANDRY**

**Chapter Objectives**

After completing a study of this chapter, you should be able to:

- Define what animal husbandry is all about.
- Identify various types of livestock.
- Explain their importance.

**Farm Livestock**

This refers to the proper rearing and breeding of animals (cattle; goats; sheep; pigs; horses etc)

## **The importance of livestock in general**

### **Importance**

- Provide draught power.
- Symbol of wealth.
- Provide manure
- Source of transport e.g. donkeys.
- Paying Lobola.
- For appeasing spirits.
- Provides hides and skins.
- Source of food e.g. meat, milk, etc.
- Generate foreign currency.
- For tourist attraction.
- For educational purposes.

### **Types of farm livestock**

#### 1. **Ruminants**

- Have (4) four chambered stomachs
- Chew cud
- Have two toes
- Are herbivores

### **Examples of ruminants**

- Sheep, cattle, goat, Impala, Kudu

#### 2. **Non-Ruminants**

- These are animals with one stomach and do not chew cud.
- Some have one toe and some have two toes e.g. pigs
- They are omnivores.

### **Examples**

- Donkeys, pigs, rabbits, dogs, cats, etc.

#### 3. **Poultry**

- It is the keeping of different types of birds? Examples include: chickens, ducks, doves, geeses, turkeys, guinea fowls etc.

#### 4. **Fish**

- They are kept for meat e.g. tilapia, carp, bream, mackerel, trout etc.

5. **Bees**
  - They are insects reared for honey production.
  - Help in pollination of flowers or crop plants.

### **Questions**

1. State the importance of farm livestock
2. Distinguish ruminants from non-ruminants and give examples on each.
3. Why do farmers rear bees?

# **CHAPTER 26**

## **ANATOMY AND PHYSIOLOGY**

### **Chapter Objectives**

After Completing a study of this chapter, you should be able to”

- Define Anatomy and physiology
- Draw a diagram of the anatomy of an animal and label it.
- Explain the functions of the parts of an animal.

### **Digestion in Rumen**

This refers to the biological make up of the body of animals. A study of the biological components of an animal, is the science of anatomy and physiology.

## Digestion in Animals

It is the breakdown of large molecules or particles into smaller particles which can easily be absorbed into the blood stream.

### Types of digestion

#### 1. Physical Digestion

- It is breakdown by teeth in the mouth.

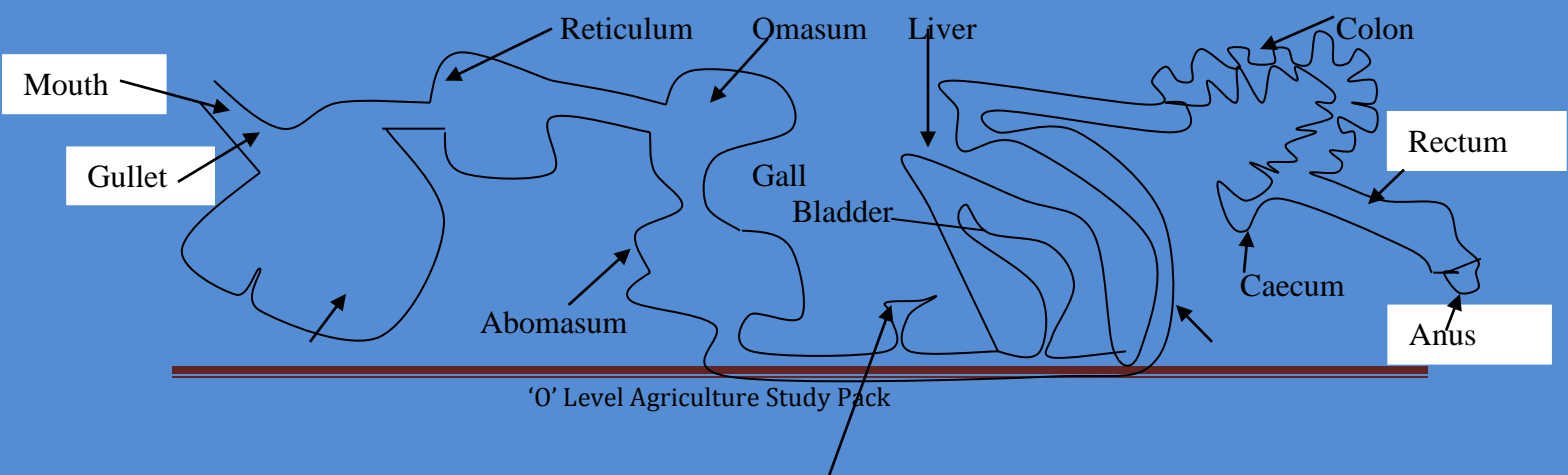
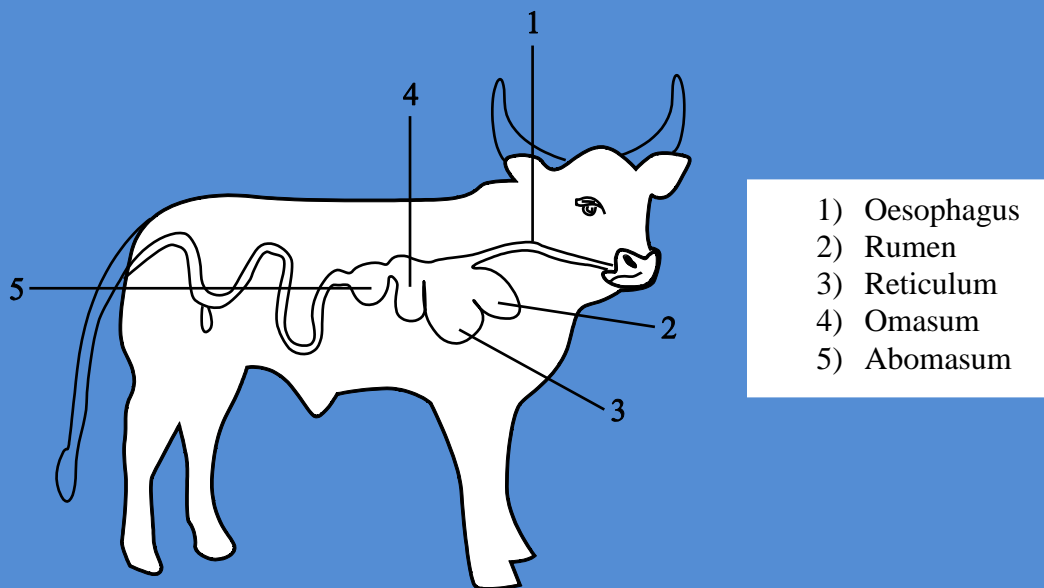
#### 2. Bacterial/Biological Digestion

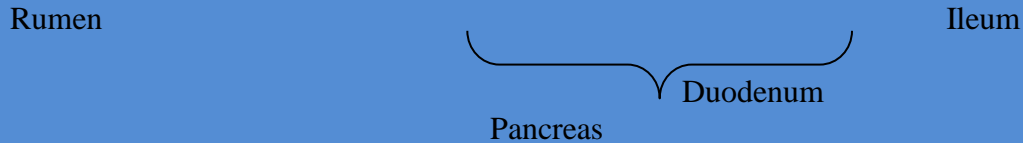
It is breakdown of food by use of bacterial flora fluid from ruminal bacteria.

#### 3. Chemical digestion

- It is done by use of enzymes produced in the digestive system.

### Digestive system of a cow





### **Functions of parts**

1. **Mouth-** Chews and mixes food with Saliva.
2. **Gullet-** Passage of food to the rumen.
3. **Rumen-** Stores roughage before rumination, it is softened, in the rumen. Fermented and broken down by bacteria
4. **Reticulum**
  - Bacterial digestion continues.
  - Traps foreign material.
  - Food boluses the are formed and later sends the back to the mouth for rechewing.
5. **Omasum**
  - Grinds/chews food to a fine mixture for easy absorption.
6. **Abomasum**
  - Enzymatic digestion continues here and proteins are digested in this chamber.
7. **Duodenum**
  - Region-breaks down fats into fatty acids and glycerol by bile.
8. **Ileum**
  - Absorps digested food into the digestive system.
9. **Colon**
  - Absorps waters from the undigested food.
10. **Rectum**
  - Shapes faeces before being discharged off. Also stores faeces.
11. **Anus**
  - Passage for dung.

### **Questions**

1. What is digestion?
- 2a) Draw and label a diagram of the digestive system of a ruminant animal
- b) Describe how food is broken down from the mouth to the abomasum stomach.
- 3a) State 3 types of digestion
- b) Explain the differences between chemical and biological digestion in ruminants.



# CHAPTER 27

## ANIMAL NUTRITION

### Chapter Objectives

After completing a study of this chapter, you should be able to:

- Define what animal nutrients are.
- Identify the various nutrients needed for good health of animals.
- Explain the functions of each nutrient.
- Identify food-stuffs that have the various nutrients.

### Nutrition

This means providing animals with food which has all the nutrients for the best performance of the body.

Nutrients are that part of the food which is digested and utilized by the animal.

### Types of nutrients

#### 1. Carbohydrates

### Functions of carbohydrates

- Supply energy for body functions e.g. digestion, pumping blood, movement etc.
- Provide warmth.

### Sources of carbohydrates

- Cereals- like maize, grass, sorghum etc.

## 2. Proteins

### Functions of proteins

- For body building/growth
- Forms part of the enzymes, hormones haemoglobin, cell walls and all structural tissues.

### Sources of Proteins

- Beans ,milk, meat, bone meal, fish meal, peas, groundnut seed cakes, etc

## 3. Vitamins

They maintain health of the animals.

### Sources of vitamins

- Fish liver, wheat germ, dry grass, legumes

## 4. Mineral salts.

### Functions of mineral salts

- Help in the formation of body tissues like bones, teeth and blood.
- Help in chemical reactions which take place in the metabolism of the animal.

### Sources

- Milk, fish, meat, green plants, iron, salt, etc.

## 5. Fats

### Functions of Fats

- Provide energy.
- Protect delicate organs e.g. kidneys and the heart.
- Deposited for the absorption of vitamin A and Carotene.

### Sources of Fats

- Sunflower seed, groundnut seed, soya bean.
- Seed and foliage, palm kernel coat and in cells of plants

## 6. Water

It constitutes up to % of the body of an animal.

### Functions of water

- Major constituent of all cells.
- Main constituent of all body fluids e.g. saliva, blood plasma, synovial fluids and serum.
- Helps transport nutrients to all parts of the body.
- Vital for enzyme reactions.

### **Factors affecting water intake by an animal.**

- High temperature.
- Water temperature
- Amount of Salt in diet.
- Age in animal.
- Activity of animal.
- Health of animal.

### **Types of livestock feeds**

#### **1. Roughages**

- They have a high fibre content and low protein content. Less moisture content (less than 10%).

#### **2. Concentrates**

- They have a low fibre content, and a high digestible protein nutrient content (70%)

#### **3. Succulents**

- Have a high water content
- Have only 30% dry matter e.g. sweet potatoes, melons, green Lucerne, green grass etc.

#### **4. Hay-**

It is dry grass that has been sun dried to feed livestock when the veld is dry without food. Fibre content is high.

### **Rations**

- They are measured amounts of food or feed given to an animal per day

### **Types of rations**

#### **1. Maintenance ration**

- Refers to food given to an animal in order to maintain production of product e.g. milk, etc
- Animal does not gain or lose condition, e.g. weight reduction or increase or decrease in milk or increase production.

#### **2. Production ration**

- Is an extra food given to an animal for it to gain weight, produce milk, eggs or feed young ones.

#### **3. Balanced ration**

This refers to food which contains all the required important nutrients in appropriate quantities.

NB

**AD-lib feeding** is continuous liberal supply of food to animals. Food is always full in troughs.

**Factors affecting food intake**

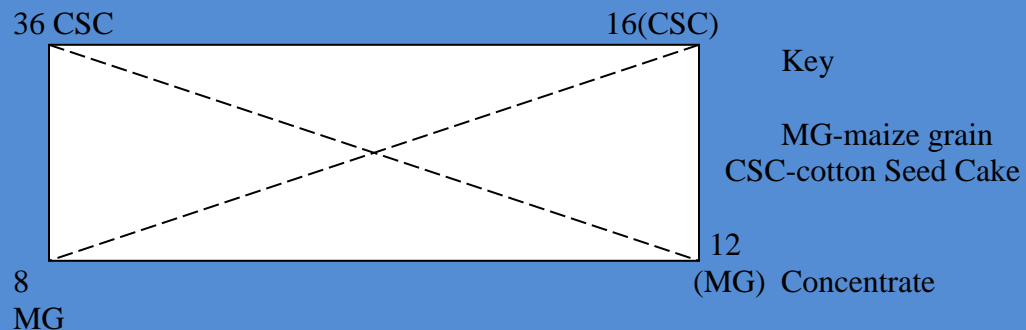
- Palatability of food.
- Body weight.
- Individuals.
- Type and level of production.
- High temperature.
- Amount of salt in food.

**Pearson square**

- It is a method used to mix livestock rations.

**Examples of Pearson Squares**

- An animal requires 24% digestible protein daily,
- Available for formulation of a feed are cotton seed, cake concentrate (36%DP) and maize grain (MG) (8, 0% DP).
- Use the Person Square method to determine proportions of maize and cotton seed cake to mix to form a supplement.



**Answer**

- There are 16 parts of cotton Seed Cake concentrate, 12 parts of maize grain.
- These will produce a mixture with a digestible protein of 24%
- $36\text{CSC} - 12(\text{MG}) \text{concentrate} = 24\% \text{ digestible protein.}$

**Questions**

1. What are the functions of the following food nutrients:
  - (a) Carbohydrates?
  - (b) Proteins?
  - (c) Fats?
  - (d) Water?

2. State sources of food for each.
3. Give factors affecting food intake by an animal
4. Differentiate the following terms:
  - (a) Maintenance and production ration
  - (b) Roughage and concentrates.

## **CHAPTER 28**

### **REPRODUCTION IN RUMINANTS**

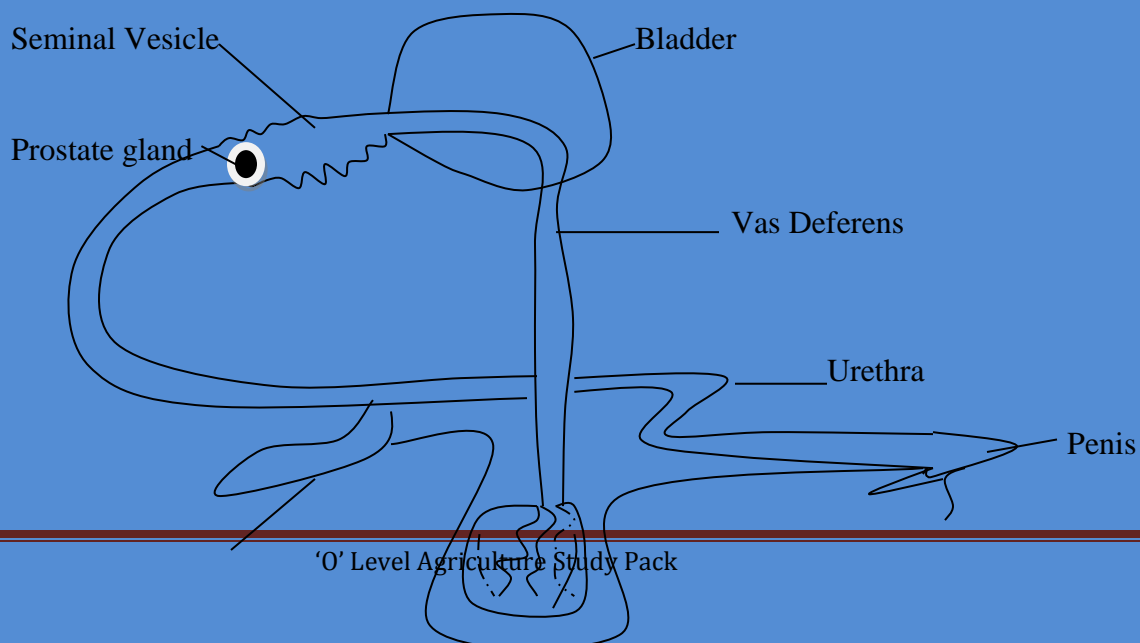
#### **Chapter Objectives**

After completing a study of this chapter, you should be able to:

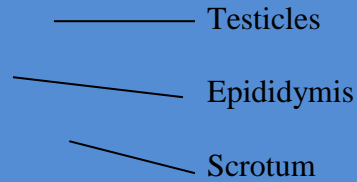
- Draw diagrams of reproduction systems in animals.
- State the signs to show that female animals are on heat (cows)
- Describe how to determine pregnancy in cows.

It is the process involving courting, mating and gestation to produce young ones.

#### **Reproductive system of a bull**

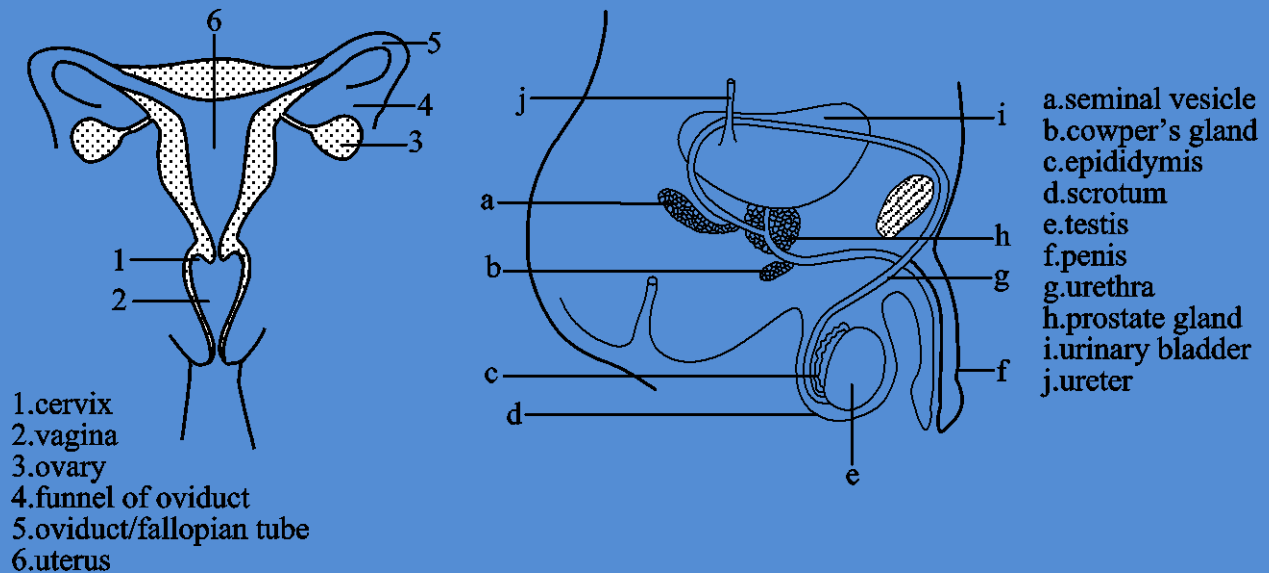


Retractor Muscle



1. Testicles-Manufactures sperms.
2. Spermduct-Carries sperms from epididymis to seminal vesicle.
3. Epididmis-Store sperms to mature before ejaculation.
4. Seminal vesicle-Produces semen, store semen and dilute semen with sperms
5. Penis-For urine excretion and copulation.
6. Scrotum-Contains testis and maintains temperature of testicle.

### Female and Male reproductive parts



1. **Ovaries**
  - Produces ova and secrete oestrogen.
2. **Fallopian tube**
  - Provide a passage for the ova to the uterus.
  - It is also an area of fertilization.
3. **Uterus**
  - Is an area of implantation

- Protects foetus.
  - Nourishes the foetus.
  - Help push the foetus during parturition.
4. **Cervix**
- Prevents entry of bacteria into uterus
  - Closes after fertilization as prevent the foetus from early release
5. **Vulva**
- Helps show foetus period and protects vagina.

### **Signs of heat/oestrus period**

- Swollen and moist vulva.
- Reduced milk output.
- Cow quickly stands when mounted by a bull.
- Mounting of other cows by those on heat.
- Moves up and down restlessly.

### **Gestation**

- It is the period between fertilization and birth or period between conception and birth.
- The fertilized egg moves into the womb where it develops into an embryo and later a foetus.

### **Pregnancy diagnosis**

- This is a process of finding out whether an female animal has conceived or has not.
- This is done five months after mating

### **Criteria used to determine pregnancy**

- Absence of heat
- Change in contour of abdomen
- Bellying down
- Reduced milk output.

### **Questions**

1. Draw and Label diagrams of the reproductive system of:
  - (a) Bull
  - (b) Cow
2. State four signs of heat in cows
3. How do you determine pregnancy in ruminants.

# CHAPTER 29

## ANIMAL IMPROVEMENT

### Chapter Objectives

After completing a study of this chapter, you should be able to:

- Define what breeding and animals improvement are about.
- State reasons for breeding animals.
- Explain difference between mitosis and mitosis.
- Give stages of mitosis.
- Distinguish in-breeding and cross breeding.

### Breeding

It is the controlled production of groups of animals, whose parentage is known for the purpose of increasing number of animals/improving characteristics of animals.

### Reasons of breeding/improvement

- To achieve high milk yield
- To improve growth rate
- To improve meat to bone ratio
- To improve resistance to diseases
- To improve adaptability to different climatic conditions.

### Genetics

It is the study of the way plants and animals pass on their inheritable characteristics to their off springs.

### Mitosis



It is the division of the nucleus into two nuclei that are identical to one another, and to their parent's nucleus genetically.

### Stages of Mitosis

These are:

- Prophase
- Metaphase
- Anaphase
- Telophase

### Importance of mitosis

- Maintains constant chromosome number.
- Helps increasing the number of cells which replace worn out tissue or effecting growth.
- Necessitates asexual reproduction.

### Meiosis

It is a reduction division resulting in the nucleus dividing into four daughter nuclei.

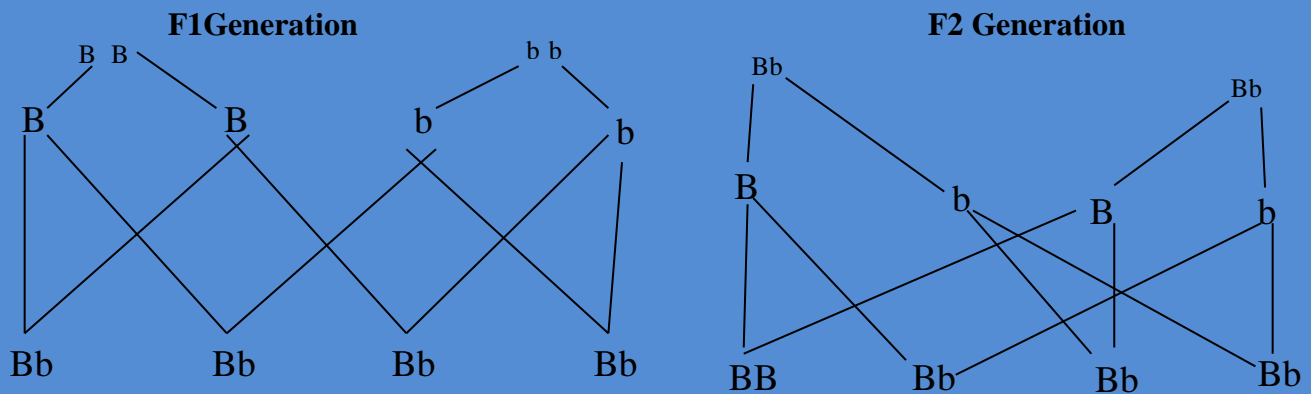
### Stages of Meiosis

These include:

- Prophase
- Metaphase
- Anaphase
- Telophase

### Cross testing

- Involves the mating of an animal with a known homozygous to establish its genotype.



### Selection

It is a process of choosing which animals to use for mating.

### Breeding system

(a) **Inbreeding**

- Is mating of closely related animals e.g. father and daughter, mother and son or brother to sister.

**Advantages**

- Desirable traits are continually passed in the family
- Helps in developing uniformity

**Disadvantages**

- May concentrate undesirable traits
- Animals may end up with reduced vigour in some traits.

(b) **Cross breeding**

- Involves mating purebred animals with different breeds e.g. Mashona cow and Brahman bull.

**Advantages**

- They improve performance.

(c) **Upgrading**

- Involves mating pure hybrid breeds.

(d) **Line breeding**

- Involves mating of animals that are closely related.

**Advantages**

- Method, increases variability, fitness and adaptation to environment.

**Selection of animals for breeding methods.**

- Progeny quality
- Individual selection.

**Questions**

1. State five reasons for breeding farm animals
2. Explain the differences between mitosis and meiosis
3. Give 4 stages of mitosis
4. Distinguish inbreeding from cross breeding.

# CHAPTER 30

## ANIMAL HEALTH

### Chapter Objectives

After completing a study of this chapter, you should be able to:

- Identify the various types of diseases affecting animals.
- Explain the symptoms of the diseases
- Describe the methods of control of diseases.
- Identify the cause of animal diseases.

It is an act of caring for animals to make sure disease and parasite attack is put under control so as to maintain animals in good health.

### Signs of good health

- Sharp appetite.
- Bright eyes.
- Alert ears.
- Moves its tail to chase away flies.
- Has a bright and shiny coat.
- Excite normal faeces and urine.
- Gains weight as it matures.
- Has a normal pulse rate, temperature, respiration, and breathes normally.
- Has a good gait.

**Causes of diseases**

- Virus.
- Bacteria.
- Protozoa.

**Other causes**

- Nutritional deficiency.
- Poisoning by plants such as slangkop, tulip.
- Injuries.

**How diseases are spread**

Diseases spread in different ways through:

- Sneezing, coughing and breathing.
- Drinking contaminated water-by urine and faeces.
- Contact with infected animals.
- Close proximity.
- Through vectors e.g. tsetse flies and ticks.

**How to prevent diseases**

Diseases are controlled by:

- Good housing facilities.
- Nutrition- balanced diet.
- Providing strict hygiene conditions.
- By isolating sick animals.
- Separation of old and young animals.
- By guaranting animals.
- Dipping animals.
- Dosing animals.
- By burning or burying dead animals.

**Controlling of diseases in animals**

It is done by:

- Vaccines before attack.
- Injecting with antibiotics.
- By drenching or dosing to kill internal parasites.
- Dipping or spraying external parasites.
- Dusting.
- Quarantine affected animals

**Immunity**

- It is the ability of animal to resist disease infection.

**Types of immunity****(a) Natural acquired immunity**

- It is immunity acquired through natural means.

### **Types of Acquired Immunity.**

#### (i) **Natural acquired passive immunity**

- It is when an animal does not make immunity on its own.
- Instead, mother gives antibodies to the offspring through colostrums.

#### (ii) **Natural acquired active immunity**

- Lasts longer because it is produced after an animal has been attacked by a disease, hence stimulated to produce antibodies, to fight diseases any time.

#### b) **Artificially acquired immunity**

- Is immunity acquired through artificial means.

### **Types of artificially acquired immunities**

#### (i) **Artificially acquired passive immunity**

- Is injecting serum from an infected animal which has developed immunity into another animal.
- Animal will respond by producing antibodies.

#### **Artificially acquired active immunity Immunity**

- Acquired after an animal has been vaccinated with weak pathogen, as if it has been attacked, thereby producing more antibodies.

### **Notifiable diseases/ scheduled diseases**

These are diseases that are deadly and can not be cured, and if discovered, should be reported to the police, Ares officers, or veterinary officers.

### **Reasons for controlling them**

- They kill even human beings.
- They can not be cured.
- They spread fast.
- They lead to stoppage of exports of meat.

### **Ways of controlling notifiable diseases**

This is done in many ways, which include:

- Burning or burying dead carcasses.
- Vaccinating before attack
- Report any outbreaks
- Isolate sick animals
- Quarantine all newly bought animals.

**Questions**

1. State four signs of good health in farm livestock.
2. What are the causes of animal diseases?
3. How are animal diseases spread?
- 4a) How can a farmer control or prevent animal diseases?
  - b) Distinguish between natural acquired immunity and artificially acquired immunity.
- 5a) How can a farmer control notifiable diseases?
  - b) Why is it important to prevent or control notifiable diseases?

**Diseases of animals****Bacterial diseases**

- (i) **Anthrax**  
It is caused by bacteria

**Signs**

- Shivering.
- Passing out of non-clotting blood through all natural openings at death.
- Sudden death.
- Blood stained faeces.

**Control**

- Bury dead animal deeply or burn.
- Do not eat anthrax infected meat.
- Vaccinate animals with anthrax vaccines.

**Treatment**

- No cure of anthrax is available yet.

- (b) **Protozoal diseases**

**Coccidiosis.** It is caused by a protozoa.

**Signs**

- Passing out blood stained faeces.
  - Affected chickens or rabbits appear depressed and drowsy.
  - High mortality rate.
  - Drooping wings.
  - Diarrhoea.

**Control**

- Isolate sick chickens.
- Kill all affected birds.
- Feed birds with feed which contain coccidiostats.

**Treatment**

- Put the following drugs in water:
- Esb3, sulpha mezathnie tablets.

**Viral diseases**1. **Foot and mouth diseases**

It is caused by a virus.

**Signs**

- High fever.
- Continuous salivation.
- Lameness due to the blisters on feet.
- Watery and painful blisters on mouth and feet and tongue.

**Control**

- Slaughter affected animals.
- Ring vaccination to be done.
- Burn or bury dead carcasses.
- Vaccinate before attack.

**Treatment**

- No treatment.

**Government legislation**

They are laws gazetted by the government to guard against diseases. There include:

1. Importation of livestock:  
All animals are allowed in the country upon production of a veterinary certificate to ensure that they are disease free.
2. Quarantine new animals to allow for disease checks.

**Parasites**

These are organisms which derive food from other organisms, but don't contribute anything beneficial to the host.

**Types**(a) **External Parasites**

They feed from outside e.g. ticks, lice, fleas

(b) **Internal Parasites**

They feed from inside e.g. liver fluke, tapeworm, roundworm

## External parasites

### Ticks

#### Harmful effects of ticks

- Cause anemia through loss of blood.
- Cause wounds.
- Damage hides.
- Transmit diseases e.g heart water.
- They irritate animals.

#### (A) One Host tick (e.g.)Blue ticks

##### Lifecycle

- Adult females lay eggs.
- Eggs hatch into Larva.
- Larva attaches itself to host.
- Engorged larva, moult while on host to nymphs.
- Nymph feed on same host.
- Engorged nymphs moults to adult.
- Adult male and female mate on host and engorged female drops to lay eggs.

#### Diseases transmitted by Blue ticks

- Red water.
- Gall sickness.

## Internal parasites

### (A) Roundworms

Their hosts are:

- Pigs.
- Cattle.
- Sheep.
- Goats.

#### Lifecycle

- Eggs are laid in the host and these are passed out in faeces on the ground.
- Eggs hatch into larva which, when picked up by the host animal, will develop in adult worms.
- Adult worms burrow through the ileum into the heart and move in blood vessels to the lungs.
- They are then coughed out from lungs and re-swallowed to reach intestines.

#### Signs of attack

- Emaciation of infected animals
- Diarrhoea
- Loss of blood (anemia)



- Rough coat
- Loss of appetite

### **Prevention**

- Dose animals once every 3-4 weeks in summer and early winter.
- Prevent animals from grazing on dumpy areas.

### **Treatment**

- Dose with trodax
- Avoid dirty pens/Kraals.

### **Questions**

1. Discuss Anthrax and Foot and mouth diseases under the following headings:
  - (a) Cause
  - (b) Symptoms
  - (c) Prevention or control
  - (d) Treatment
- 2 (a) What are the harmful effects of ticks?
  - (b) How can a farmer control ticks?
3. Describe the lifecycles of:
  - (a) One host tick
  - (b) Roundworm
4. Suggest ways of controlling roundworms.

# CHAPTER 31

## WILDLIFE MANAGEMENT

### **Chapter Objectives**

After completing a study of this chapter, you should be able to:

- Explain why wildlife is important.
- Explain why wildlife and humans conflict.
- Give the functions of CITEs and CAMPFIRE.
- Explain the terms biodiversity, Ecology, Ecosystem.
- This refers to all practices of sustainable utilization of non-farming resources or, refers to all living organisms that occur naturally.

### **Importance of wildlife management**

- Tourist attractions.
- Creates employment.
- Earns foreign currency.
- Helps improve the lives of rural people through Campfire programmes.
- Helps in the preservation of endangered species.
- Makes use of areas not suitable for any crop production.
- Provides meat.
- Creates entertainment through hunting, photography and game viewing.
- Provide cultural regalia in form skins.
- Source of medical raw materials. e.g. rhino horns.

### **Wildlife management involves:**

- Guarding against poachers.
- Giving supplementary feeds to animals.

- Provision of water for drinking.
- Catering for disease outbreak.
- Culling terminally ill animals.

**NB:**

- In Zimbabwe wild animals are kept in game reserves or parks e.g Gonarezhou, Hwange game reserve, Snake Park etc.

**Conservation**

- Encompasses sustainable utilization of existing wildlife resources.

**Conflicts between humans and wildlife.**

- Competition for water and food.
- Animals (e.g elephants) destroy man's crops.
- Man hunts down animals.
- Leopards, Lions etc attack humans.

**Roles of National Parks**

- They are responsible for research e.g. investigation and monitoring animals.
- They protect animals from attack by man (poaching).

**NGOs (Non- Government Organizations)**

They help the government by funding research, protection and development of game parks.

**CITES**

- Affects the marketing of Wildlife products.
- Caters for species treated with extinction e.g. black Rhinos.

**CAMPFIRE**

**Functions of CAMPFIRE**

- Protects trees and wild animals against poaching
- Used to improve infrastructure e.g. roads
- Generate funds which are used to build schools, clinics etc for rural communities.
- Community gets forex through tourism in game parks etc.

**Biodiversity**

It is regarded as the sum total of species in nature or the variety and reliability among living organisms and the ecological complexes in which they occur.

**Types of biodiversity**

- Gene Biodiversity**-Implies the number of genetic characteristics of species.
- Habitat diversity** Is the variability of habitats in a given locality (area)
- Species diversity**- Is the variability of species in a given area.

**Ecology**

This refers to the study of the interrelationships between organisms and their habitats.

**Ecosystem**

It is the natural unit in which the lifecycle of plants, animals and organisms are linked to each other, and to the non-living constituent of the environment to form a natural system.

**Adaptation to environment****(1) Feeding habits**

- Some animals spend the day asleep and feed during the night, e.g. owl rabbits.

**(2) Camouflage**

- Colour of skin of animals resembles that of its surroundings e.g. Chameleon change colour to that of the environment.

**(3) Sentinels**

- Happens when some animals in a group keep guard to warn other members of the group about impending danger e.g. baboons.

**Wildlife Habitat****Habitat**

- It is natural home for wildlife.
- This includes grasslands, velds, dams etc.

**Breeding Patterns****Factors affecting breeding.**

- (i) Availability of food.
- (ii) Protection from danger.
- (iii) Breeding seasons. (Each animal has its own breeding season or time).

**Questions**

1. Why is wildlife important?
2. Why do Wildlife and human beings fight?
3. Give functions of CAMPFIRE
4. Explain the term Biodiversity
5. Distinguish Ecology from ecosystem
6. List factors affecting breeding patterns of Wildlife.

# CHAPTER 32

## FARM STRUCTURES AND MACHINERY

This refers to the arrangement of the farm projects and the machinery needed for the farm to achieve its aims.

### Chapter Objectives

After completing a study of this chapter, you should be able to;

- Describe the various structures and implements are.
- Describe the various structures and implements.
- Explain their advantages and disadvantages.
- Give a list of materials used for fencing structures.

### Fencing

- Is a barrier which can be made from:
  - Wooden poles.
  - Stands of wire.

### Uses of a fence

- Control movement of animals and people.
- Prevent animals from entering or leaving particular areas e.g. fields.
- Demarcate boundaries.
- Construct poultry structures.
- To avoid boundary disputes.
- Hedge fence add beauty to farms.
- Enables mixed farming to be carried out easily.
- Enables farmers to isolate sick animals out easily.
- Enables farmers to isolate sick animals or in-calf cows.
- Facilitate rotational grazing

- Facilitate early and late planting
- Mark territories.

## **Types of a fence**

### **1 Barbed fence**

#### **Advantages**

- It is not affected by drought.
- It is very strong.
- Takes a short time to erect.
- Can be altered to need.
- Very effective.

#### **Disadvantages of a barbed fence**

- Very expensive
- Need skilled people to strain
- Can cause injuries during erection.

### **2. Live or hedge fence**

#### **Advantages**

- Add beauty
- Act as a wind break
- Makes a complete barrier.

#### **Disadvantages**

- Can be affected by drought.
- Can be affected by pests and diseases.
- Not effective in controlling animals.
- Takes a long time to establish.
- Can be poisonous to animals.

#### **Factors considered when choosing hedge fence**

- Fast growth rate.
- Should not be edible to animals.
- Should be bushy.

### **3. Wooden fence**

#### **Advantages**

- Cheap.
- Resources are readily available.

#### **Disadvantages**

- Not durable.
- Affected by termites and ants.

- Can easily rot.
- Leads to deforestation.

## **Materials used in feeding Pens**

### **1) Wooden posts**

#### **Advantages**

- Can be easy to find.
- Can be cut into different lengths desired.
- Last longer if treated.

#### **Disadvantages**

- Can be affected by fire.
- Are bulky and heavy.
- Can be affected by water.

### **Metal Posts**

#### **Advantages**

- Are durable
- Easy to work on with
- Less bulky

#### **Disadvantages**

- Expensive to purchase
- Can be affected by rust.

### **2. Concrete posts**

#### **Advantages**

- Can be made on the farm.
- Are durable, once casted.

#### **Disadvantages**

- They are heavy.
- They take time to set.
- One can not use nails.

### **3. Standards**

- Used to hold up wire between corners.
- Are 1,8m long x 5 to 10cm thick, spaced at 14m apart on boundary and 18m apart on internal fence.

### **4. Droppers**

- Used for spacing wire strands placed between standards
- They do not touch the ground.

**5. Anchors**

- Support corner posts, straining posts and gate posts so that they will not fall or follow the directions of strain during straining.

**Treatment of Fencing Posts****Reasons**

- Protects posts from termites, ants and from rotting.

**Procedure of treatment posts**

- Immerse posts in boiling creosote in drums
- Posts are left in creosote for several hours
- Leave them to cool down and creosote to drip off.

**Erection of fence**

- Mark the corner posts and line of fence.
- Anchor corner posts and straining posts.
- Put standards along the line of fence.
- Strain the wire, starting with the top strand.
- Use a wire strainer to pull the wire.
- Place droppers after straining so as to space the strands.

**Questions**

- (a) What are the reasons for fencing?
  - (b) What are the advantages of the following types of fence:
    - (i) barbed wire fence
    - (ii) Hedge Fence
    - (iii) Wooden fence
- (a) Lists (3) three materials used for fencing and give the advantages of each
  - (b) Give two reasons for treating fencing posts.



# CHAPTER 33

## FARM BUILDINGS

### Chapter objectives

After completing a study of this chapter, you should be able to:

- Give the factors that are considered when choosing site for farm buildings
- List the types of materials that can be used for constructing farm structures.
- Give the advantages and disadvantages of various materials for construction of farm structures.

### Site selection: Factors to consider

- Accessibility
- Nearness to the farm house
- Downward side to avoid smells
- Soil drainage
- Near a permanent water supply
- Aspect-should not be affected by direct sunlight

### Materials used for farm buildings

#### 1. Wood

- For roofing
- For flooring
- Siding rails on railway tracks.

### Advantages of wood

- Easy to work on
- Readily available

### Disadvantages of wood

- Decays easily
- Prone to termite attack
- Needs limited load

## 2. Thatch grass on farm houses

-For roofing.

### Advantages of thatch grass

- Readily available
- Thatch grass has a better insulation properties
- Burns easily
- Rots easily

## 3. Concrete blocks

Used for making foundations.

- Construct walls.
- For making posts.

### Advantages of concrete blocks

- Very strong

## 4. Bricks

- Used for decorative purposes.
- Used for construction of buildings.

### Advantages of bricks

- They are strong.

## Questions

1. State five factors considered when choosing building materials
2. What are the functions and advantages of the following building materials:
  - a) Wood
  - b) Thatch grass
  - c) Concrete

# CHAPTER 34

## FARM ROADS

### Chapter Objectives

After completing a study of this chapter, you should be able to:

State the factors considered when sitting farm roads.

State the differences among the various drainage systems.

State routine maintenance practices carried out on farm roads.

### Requirements for farm roads

The roads that lead into, and around the farm should be:

- (i) Accessible.
- (ii) Trouble free and easy to maintain.
- (iii) Built on a well-drained area free from erosion.

### Siting of roads

This depends on:

- Topography.
- Type of road, i.e., permanent or feeder roads.
- Drainage.

### Farm roads dimensions and shape

#### (a) Road Width

This varies with purpose, type of traffic and intensity.

- Smallest road should be across 3m crown and large ones-6m wide

#### (b) Road Shape

- Roads have raised crowns, or are cambered to shed off water.

(c) **Height**

- Roads are 15-30cm high above the surrounding land and is maintained by means of a grader.

**Drainage**

- It is done by use of the following structures:

(i) **Mitre drains**

- They lead water from the side of roads into streams.

(ii) **Inverts**

- These are (Shallow depressions), constructed across the road to allow water to cross the road
- They are constructed using concrete.

(iii) **Culverts**

- Are large pipes constructed across small streams across roads to carry water under the road.

**Road construction**

- Done by graders. Top soil is removed and gravel is scooped.
- The road is pressed using rollers.
- Construct cambered crown road
- Construct side drains, inverts, culverts.

**Maintenance**

- Grade roads periodically.
- Fill pot holes with gravel.
- Don't use sleighs on roads.
- Avoid driving cattle in the roads.
- Drivers should use the whole road surface.

**Questions**

- 1 (a) State three factors considered when sitting farm roads.
- (b) State the differences among the following road drainage systems:
  - (i) Mitre drains.
  - (ii) Inverts.
  - (iii) Culverts.
2. State the routine maintenance practices carried out on farm roads.

# CHAPTER 35

## INTERMEDIATE TECHNOLOGY

### Chapter Objectives

After completing a study of this chapter, you should be able to:

- Define intermediate terminology.
- Explain how a farmer should maintain pumps.
- Describe how engine operated shellers are maintained.

This refers to any kind of machine, structure or material used on the farm that is not too complex or expensive for the farmer, but still works well. For example, if a farmer knows how to plough with oxen, he can use all other ox-drawn implements as well.

### Appropriate technology

This refers to technology that suits the particular circumstances, for example, an ox-drawn trailer made from an old rear axle from a motor car, home- designed chicken feeders, or troughs.

### Lift pump or Bush Pumps

#### Parts

- Brass cylinder, foot valves, barrel nipple, rising main, and leather seals.

#### Operation of pump.

#### Upstroke

- On upstroke, water is drawn through the foot valve into the brass cylinder
- Leather seals give a sealing effect. Hence creating a vacuum, atmospheric pressure will be working on the water
- Piston pump will be used to draw water.

#### Downstroke

- -Foot valves will close and piston valves will open and water goes in through piston valves to the cylinder. On next upstroke, pistons valve will close and foot valves open.

### **Maintenance**

- Never run a pump dry
- Grease movable parts
- Keep pump house clear and free of water
- Replace pump piston rubber regularly to keep it air tight
- Keep bearings clean

### **Maize shellers**

Maybe hand operated or power pedal or engine powered.

### **Parts**

#### **Threshing drum.**

- Concave
- Grain chute

### **Hand operated shellers**

- Cob is twisted slightly and this makes it possible for the grain to be dislodged from the cob.
- Maize cob is fed onto disc with knobs and the grain is knocked as the operator turns the handle.
- Grain fall into a tray while the cob is thrown aside.

### **Engine operated shellers**

- Threshing is accompanied by a cylindrical sieve and spiky roller which knocks the grain off the cob.
- Grain falls through the sieve to the cleaners
- Most threshing machines are fitted with a fan for cleansing which removes the weed seeds, dirt and chaff.
- Engine drawn shellers have a shaker screen and blower to remove lighter material.

### **Maintenance**

- Protect the Sheller from bad weather by greasing (to prevent corrosion)
- Lubricate movable parts.
- Grease bearings.
- Tighten bolts and nuts.
- Paint to protect from rusting.
- Replace worn-out parts.

### **Questions**

- 1) Explain the difference between intermediate technology and appropriate technology
- 2) How can a farmer maintain a bush pump?

- 3) Describe how an engine operated sheller operates, and how it is maintained.

# CHAPTER 36

## HARNESSING

### Chapter objectives

- Identify two types of oxen yokes.
- State three types of double neck yokes.
- Draw and label a diagram of a double neck yoke.
- Distinguish a single neck yoke from a double neck yoke.

### A harness

This is an arrangement of mobilizing draught animals which are tasked to do a job under control. -It is any material or equipment worn by draught animals for the purpose of pulling implements well as controlling and directing the animals at work. The pulled implements may be scotch carts, sledges, ploughs and cultivators.

### Animals harnessed

Donkeys, horses, mules, oxen etc are the usual draught animals that are tamed for harnessing.

### Yokes or oxen yokes

These are meant to harness oxen and are in two types namely:

- (i) Double neck yoke
- (ii) Single neck yoke

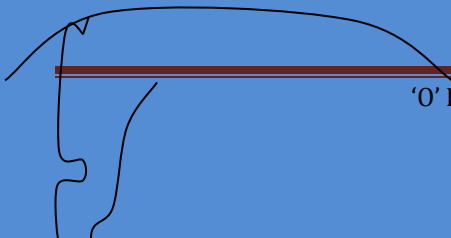
#### (i) Double neck yoke

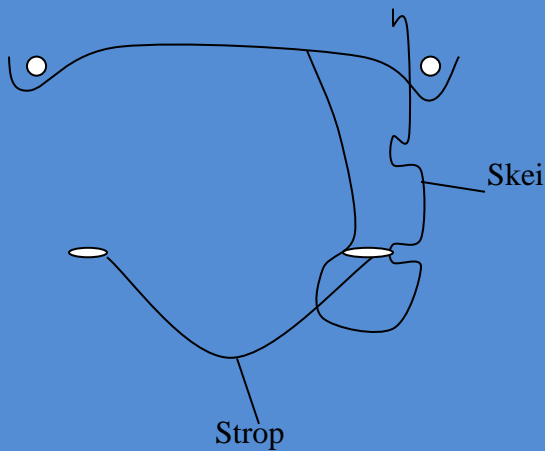
It allows animals to be harnessed in doubles or pairs (2 or 4 animals together)

#### (ii) Single neck yoke

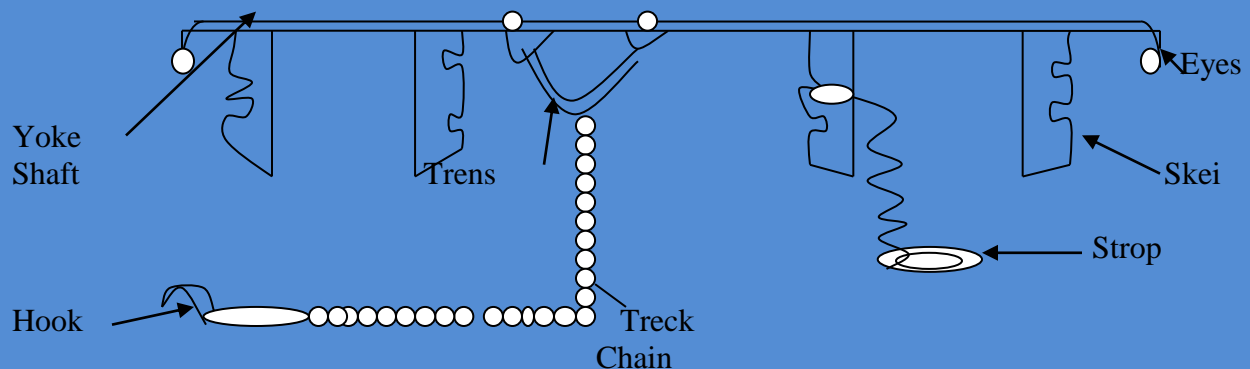
It allows only one animal to be harnessed. The diagram below illustrates a single neck yoke.

### Single neck yoke





### Double Neck Yoke



#### Parts and their functions

1. SKEI-Hold strops. They are usually made of wood. They govern the neck of the animal. They hold the stops
2. STROPS-Prevent the yoke from slipping back over the draught cattle's hump. They are usually made of sisal fibre or cattle skin or rubber
3. TRENS- attach the track chain to the clamps
4. EYE-Help guides the guiding rope along the sides of the cattle.
5. TREK CHAIN. It is the metal chain connector of the yoke and the plough

#### Types of Double Neck Yokes

##### (a) Ploughing yoke

It is 1,9m long.

- Used when ploughing, and allow oxen to be close to each other as they pull simultaneously.

##### (b) Carting yoke

- Has a long shaft (1, 7-1,9m) to allows a cultivator or cart to move between or cart to move between rows of crops.

##### (c) Cultivating York

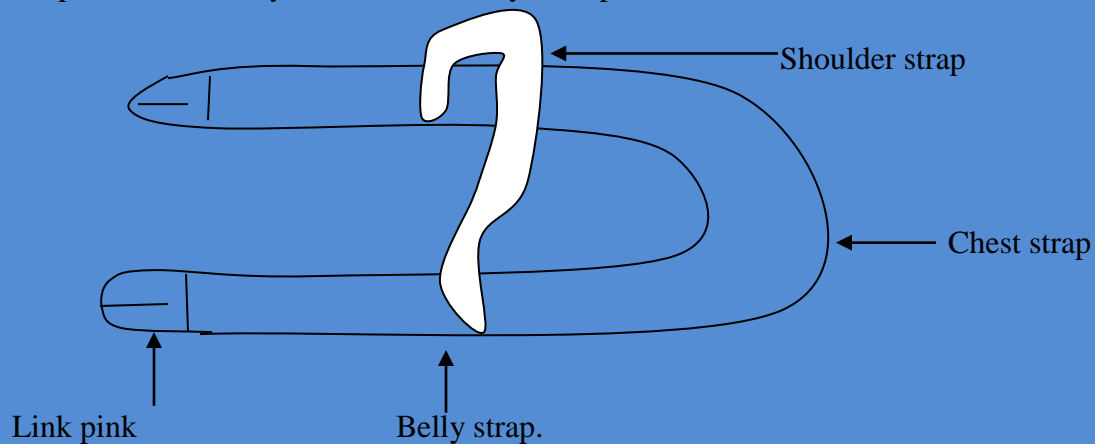


- Is 2,4m long
- Used when cultivating and allows cattle to walk apart at a distance of two rows spacing of 90cm each.

### Donkey Harness

#### Materials used

Strips of motor car tyres, raffia fibre, nylon ropes.



1. Chest strap-Enable the donkey to pull any load as it moves
2. Shoulder strap-Supports the shafts of the cart.
3. Belly strap-Prevent slipping of the shaft and pulls it when the donkey moves.

### Questions

- (i) Identify two types of oxen yokes
- (ii) State three types of double neck yokes
- (iii) Draw and label a diagram of a double neck yoke
- (iv) Distinguish a single neck yoke from a double neck yoke.

# CHAPTER 37

## AGRICULTURAL ECONOMICS

### Principles of economics

#### Chapter Objectives

After completing a study of the chapter, the student should be able to:

Explain the following principles used in agricultural economics

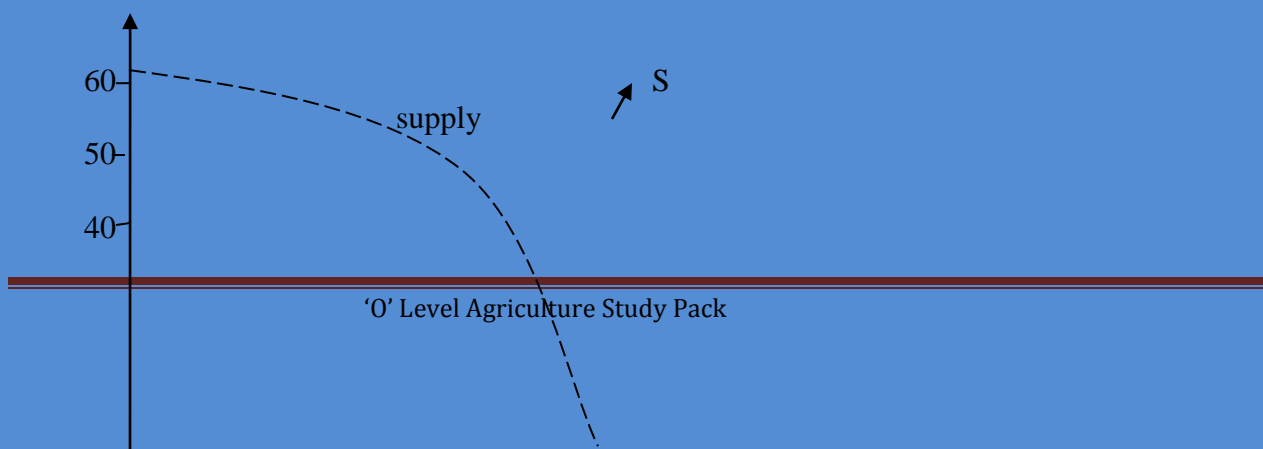
- Principle of supply
- Principle of demand
- Law of diminishing returns
- Opportunity Cost
- Give (4) four factors affecting demand of agriculture products.
- What do farmers consider when making decisions
- Differentiate risks from uncertain
- Give 4 ways of avoiding risks and uncertainty.

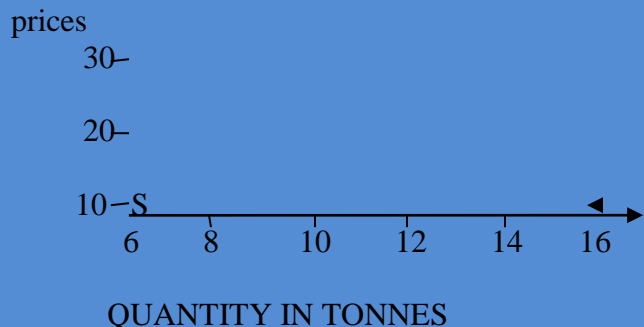
**Economics is defined as** the study of management of money and all capital resources. It is mainly about the proper use of money.

#### Principles of supply

This concept is about how much of a commodity there is for sale on the market, or the quantity of a commodity offered for sale at various prices.

NB: -The concept states that prices increase if supply is low, and falls if it is high.



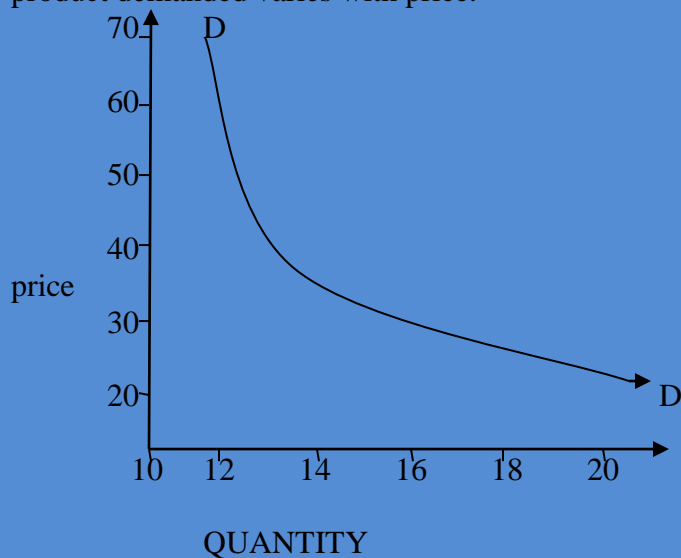


### Factors affecting supply

- Production costs. As production costs rise, less of the commodity will be produced if prices that are fetched are low, hence less will be supplied.
- Price. If prices offered are low, less will be supplied, and vice-versa.
- Political instability. When there is unstable politics in a country people may not produce enough fearing the uncertainty of war activities, hence supply will be less.
- Drought. In a drought period, less will be produced and supply will be low.
- Frost. It damages crops, hence reducing yields, resulting in low supply
- Pests. The menace of pests will affect production quantities, hence supplies will be low.

### Principles of demand

This means how keen people are willing to buy a commodity. It states that the quantity of a product demanded varies with price.



### Factors affecting demand

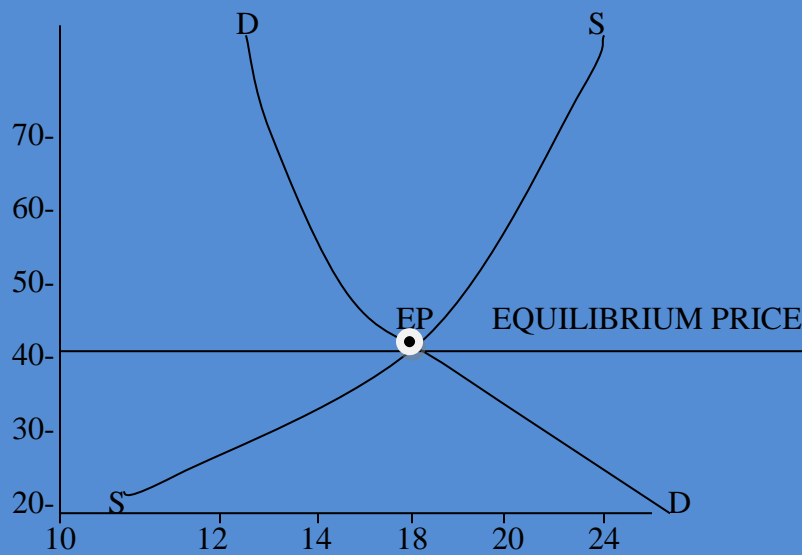
These include:

- **Income.** The higher the income, the more the goods demanded.
- **Capital saved.** If people have higher savings, they tend to demand more of the goods.
- **Price.** The higher the price, the less the good and, the lower the price, the more the goods.

- **Substitutes.** The availability of substitute goods will affect the demand for any product at any given time.
- **Taxes.** In a high tax environment, people's decisions will be affected when they decide on what to acquire and how much.
- **People's standards of living.** As people's living standard rises, the more they demand particular goods.

### Equilibrium point

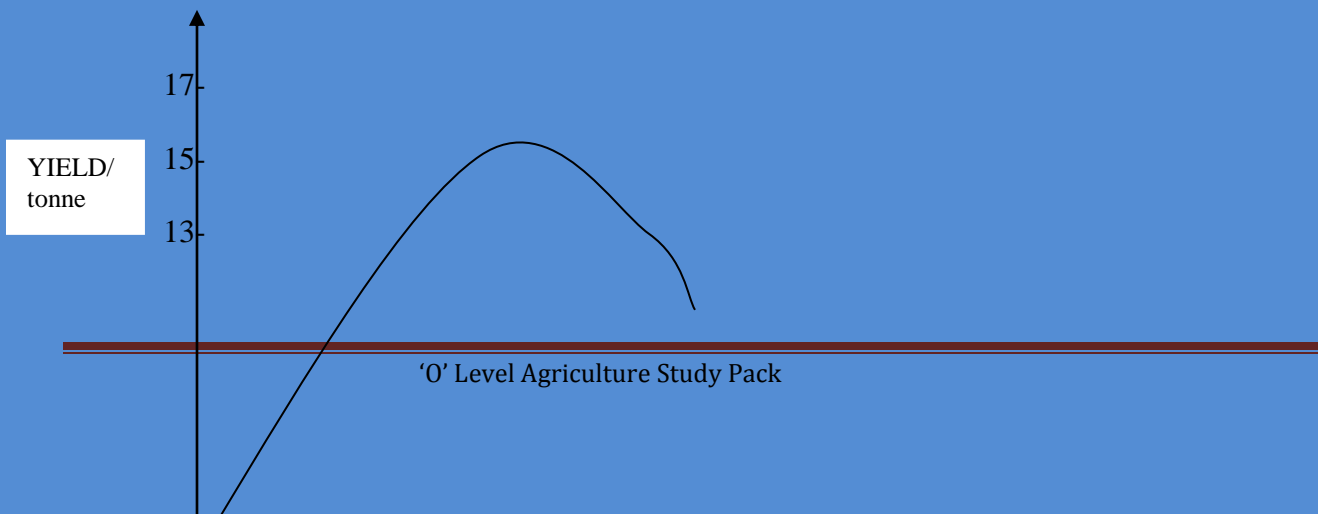
The equilibrium point is when the quantity supplied is equal to that demanded, and as such, all goods are sold at the market. All goods are bought because the price is affordable.

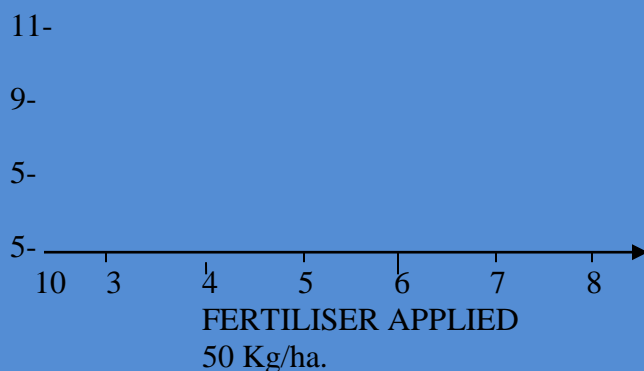


### Law of diminishing returns

The law states that there is a positive increase in output for every increase in input, but only up to a certain level beyond which the output will decrease.

The graph illustrates that the increase of fertilizer that can give maximum yield of 15 tonnes per hectare is 6 x 50kg bags. If more than 6 bags are applied, the yield per hectare will start to decline.





In short, this means that as you increase the quantity of fertilizer applied to a field, the tonnage of crop yield also increase up to a certain level, beyond which the yield starts to drop.

### **Opportunity cost**

It is the alternative that has to be forgone or chances missed in making one's choice. It is a frequency cost in order to acquire the best alternatives. To forego is abandon an opportunity in order to adopt another one that may produce better results.

The cost of losing an opportunity and chance missed in terms of monetary value is called opportunity cost.

### **Choices and decision making**

It is done by farmers after considering the input and output, to determine the profits.

### **Factors to consider in decision making**

The following factors are considered when a farmer is making farming decisions:

- Farmer's knowledge and experience. He/she considers how much of knowledge and experience he/she has to engage profitably in the activity.
- Budget. The farmer looks at the amount of resources that are available (capital) equipment and labour.
- Cash available. The farmer must assess the hard cash that may be needed to finance the activity.
- Market. The farmer must research on markets that are available to buy his/her produce.
- Environment. The farmer must study and understand the macro environment in which he/she operates. This includes the climatic environment, the political environment and the economic environment, as well as the religious and social environments.
- Available resources. This refers to the infructural factors of input resources and output facilitators like transport networks that can enable carrying of produce to markets.
- Availability of labour.
- Transport reliability.

### **Risks**

They are unforeseeable or unavoidable circumstances which affect farm projects. Risks can be insured against and can also be estimated.

**Examples**

- Drop in prices of goods
- Fertilizer costs
- Fire
- Theft
- Crop yield
- Pests and diseases
- Weather changes
- Stock feed price

**Uncertainty**

-It is an unavoidable and unpredictable circumstance which can neither be insured against nor estimated.

**Examples**

- Price fluctuations.
- Technological changes.
- Breach in contract.
- Change in government policy.
- Lack of Labour and agriculture Inputs.
- Change in demand.

**Ways of avoiding risks and uncertainties**

- These include:
- Insuring crops or animals.
- Diversify projects.
- Building own equity.
- Producing crops on contract.

**Questions**

1(a) Explain the following principles used in agricultural economics

**Agriculture economics:**

- (i) Principle of supply
  - (ii) Principle of demand
  - (iii) Law of diminishing returns
  - (iv) Opportunity Cost
- b) Give (4) four factors affecting demand of agriculture products.
- 2a) What do farmers consider when making decisions
- b) Differentiate risks from uncertain
- 3) Give 4 ways of avoiding risks and uncertainty.

# CHAPTER 38

## FARM RECORDS

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Differentiate production from financial records.
- Distinguish variable costs from fixed costs.
- Explain the following terms:
  - Gross income.
  - Gross margin.
  - Net farm profit.

### Farm records

These are daily recordings of the day to day events at the farm. A farm diary is a good example of a farm record. A stock register is yet another example.

### Reasons for keeping farm records

- To help farmers to select breeding stock.
- To help the farmer to remember his debts.
- To help farmers to see where improvements are needed.
- To find out whether one is making a profit or loss.
- To guide farmers in planning and making sound decisions.
- To help farmers compare yields and inputs from one season to the next.
- To help farmers obtain loans from banks.

### Types of records

(a) **Physical or production records**

- These show practical activities carried out in a farm from day to day e.g. weaning dates, number of machinery etc.

(b) **Financial records**

- These are records of income and expenditure on the farm e.g petty cash record, balanced sheet, loans and payments etc.

### **Variable costs**

These are costs which vary or differ with scale of production. For example a farm growing ten hectares of maize will incur more costs than one who is growing five hectares. In short the bigger the hectare, the more variable costs incurred in seed and labour etc.

### **Fixed/overheads costs**

These are costs which do not vary with scale of production. For example, rent can be fixed per month. And if one fails to use the premises for a particular month he still pays the rent, hence it is a re-current cost.

### **Expenditure**

- Is money going out of business in purchasing in puts.

### **Gross income**

- Is the amount of money the farmer obtains by selling a particular product.

### **Gross margin**

- Is the difference between variable costs of production and total income.
- $\text{Gross income} - \text{variable costs} = \text{gross margin}$

### **Net farm profit**

- Is the amount of money that remains after all costs have been subtracted from income that has been accounted for the year's operations?

NB:  $\text{Gross margin} - \text{fixed costs} = \text{net farm profit}$ .

### **Inputs**

- Are items used to produce a commodity?
- They can be known as costs.

### **Outputs**

- It is what you get after selling your products? It is also called income.

### **Questions**

- Why do farmers keep records?
- Differentiate production from financial records
- Distinguish variable costs from fixed costs
- Explain the following terms:
  - Gross income
  - Gross margin
  - Net farm profit.



# CHAPTER 39

## FARM BUDGETING

### Chapter objectives

After completing a study of the chapter, the student should be able to:

- State the functions or importance of a farm budget.
- Give sources of information for farm budgets.
- Differentiate whole farm gross margin budget from partial budget.

### Budget

The budget is an estimate of the income expected, and the expenditure the farm will incur. It is an estimate of income and expenditure expected in a farming business.

### Functions of budgets.

The following is a list of functions of budget in farming:

- Helping farmers to secure loans.
- Determining the financial requirements.
- Helping in allocation of capital to different enterprises.
- Determining expected profit.
- Helping in decision making.
- Budgets help to monitor funds in order to meet set targets.

### Sources of information for budgets

- Own records e.g. diaries, and bank statements.
- Companies that deal in selling agricultural inputs e.g. chemicals (AGRICURA; WIND MILL, ZFC).
- Government advisors e.g. AREX staff, banks, farmers' organisation e.g. CFU
- Cost of overheads e.g., licenses, telephone bills, postage etc.

When a farmer is planning up a budget for his activities, he/she has to make consultations and references. The places of reference are known as “sources of information for budgets.” Examples are:

- (a) A whole farm gross margin budget

- This involves calculating or estimating the total gross margin for all enterprises of the farm. e.g. Cotton, maize; tobacco, cattle, vegetables etc.
- b) **Partial Budget**
  - This is a technique used to determine the financial implications (whether one is making a profit or loss) of introducing a minor small change in any line of production such as maize or broiler production.

### **Questions**

- 1a) What is a budget?
- b) State the functions or importance of a farm budget.
- 2a) Give sources of information for farm budgets.
- b) Differentiate whole farm gross margin budget from partial budget.

# CHAPTER 40

## MARKETING

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- State the functions of marketing.
- Give five factors affecting agricultural marketing.
- Give the problems associated with agricultural marketing.
- Differentiate controlled marketing from uncontrolled marketing.

### Definition

Is it the buying or selling of goods and services. It involves two parties, that is, the producer and consumer. It can also be defined as the place where buying and selling takes place.

### Functions of marketing

The activities of the marketing department are known as functions. In farming the marketing function involves the following activities:

1. Buying and selling of products
2. Collection
3. Storage
4. Grading
5. Processing
6. Packaging
7. Financing
8. Risk bearing
9. Assembling of products

### Factors affecting Agricultural marketing

These include:

- Demand.
- Supply. During periods of drought, less food is harvested.
- Market. When the market is flooded by a particular good or commodity less will be supplied.
- Quality of produce. When quality is good more will be demanded, hence more will be supplied.
- Availability of Substitutes.

- Pests and Diseases. Pests and diseases affect quality and final yield. Hence, once a crop has been attacked by pests and disease, less will be harvested and less will be marketed.

### **Problems with Agricultural Marketing**

- Size of business.
- Level of production.
- Production is seasonal.
- Length of production cycle.
- Perishable goods.
- Distance from markets.
- Small internal markets.
- Shortages.
- Competition.

### **Marketing system**

**Controlled marketing**-It is that type of marketing which is controlled and operated by the agricultural marketing authority of the country e.g. Grain Marketing Board, Cotton Marketing Board, Cold Storage Commission etc. The government stipulates prices of crops to the farmers.

#### b) **Uncontrolled marketing**

- Refers to the marketing of products (voluntary) without the control of the agriculture marketing authority e.g. Colcom. The government does not intervene in price setting.

### **Questions**

- (i) What is a market?
- (ii) State functions of marketing.
- (iii) Give five factors affecting agricultural marketing.
- (iv) What are the problems associated with agricultural marketing?
- (v) Differentiate controlled marketing from uncontrolled marketing

# CHAPTER 41

## AGRICULTURAL CO-OPERATIVES

### Chapter Objectives

After completing a study of the chapter, the student should be able to:

- Give (4) four principles of co-operatives.
- State the benefits of co-operatives.
- List (5) disadvantages of co-operatives.

### A co-operative by definition:

- is when a group of people come together to form a business.

### Examples of co-operatives

Individual farmers get together to form co-operatives that produce agricultural goods for selling. They share the profits. Three types of co-operatives are noted as follows:

- Production co-operatives. For example, the Sibantubanye (ex-dissidents) co-operative in Plumtree, and the Cold Comfort co-operative in Harare
- Consumer co-operatives. These are co-operatives that by farm produce solely for example cattle farmer in Matebeleland south get together to form co-operatives that would buy fodder for their cattle during severe droughts.
- Transport co-operatives. Individuals may bring together their tracks to form a co-operative on transport which will offer a service of ferrying and delivering farm produce to GMB and Cotco.

### Principles of co-operatives

- Members contribute equally towards the cooperative
- Membership is open everybody
- Leadership posts are democratically chosen by a one person robe
- Members buy shares first
- Dividends to be shared equally
- Members need to get trained (all of them)
- Liability is equally shared by all members

### Benefits /advantages of doing a co-operative business

- Buying in bulk leads to lower costs.

- Members obtain loans easily from banks.
- Hiring transport becomes easy.
- Helps farmers to store that produce collectively until they are marketed.
- Have a big bargaining power for better prices.
- Easy dissemination of information to farmers.

### **Problems or demerits or disadvantages of co-operatives**

These include:

- Fraud by some members who may be selfish
- Political influence. Interferences by political figures who may be having hidden interests in the project may affect the co-operative
- Lack of own transport
- Lack of knowledge or technical know-how. Some co-operatives may be formed by people who do not have the technical education on the business. Such co-operatives end up collapsing.
- Lack of financial support. This may occur especially if the co-operative members have no collateral items to declare when they need loans.
- Lack of resources. Limited resources to form capital may be lacking amongst co-operative members, hence the co-operative may not grow.
- Lack of commitment from some members. Compromised participation and effort may affect the co-operative especially if members lack motivation.

### **Questions**

- i) Give (4) four principles of co-operatives
- ii) What are the benefits of co-operatives?
- iii) List (5) disadvantages of co-operatives.

## **References**

1. P.G.D. Chard and D.S. Sithole: Focus on Agriculture; A Secondary course for Zimbabwe. Book 3.  
College Press: Zimbabwe
2. B.J. Parsons: Step Ahead: New Certificate Agriculture. Book 3. Longman, Zimbabwe
3. P. Chard: Focus on Agriculture: 'O' Level Course. Book 4. College Press. Zimbabwe
4. I Mujaya: Agriculture Today Book 3  
College Press. Zimbabwe
5. I Mujaya: Agriculture Today Book 4 (Animal and Crop and Farm Structures)  
College Press, Zimbabwe.
6. G. Owen: 'O' Level Agriculture.  
Longman: U.K
7. R.I. Elliot: Agriculture for Southern Africa  
Longman. Zimbabwe
8. W.A. Sakira: 'O' Level Agriculture, Principles and Practice.  
Oxford University Press.  
Nairobi.