AGRICULTURE.

FORM ONE NOTES .

BY :KARIUKI KEN KIRIMI.

0719203386.

Kirimiken2@gmail.com.

TABLE OF CONTENTS.

CHAPTER ONE

INTRODUCTION TO AGRICULTURE.

The term agriculture is derived from two Latin words

Ager:meaning field

Cultura:field cultivation.

Therefore:

- Agriculture is an art and science of crop and livestock production.

AGRICULTURE AS AN ART ENTAILS:

- Tilling of land.
- Construction of farm structures.
- Harvesting of crops.
- Measuring of distance.
- Machine operations.
- Feeding and handling of animals.
- Marketing of agricultural produce.

AGRICULTURE AS A SCIENCE.

1) **Crop pathology.** Study of crop diseases.
2) **Entomology. The study of insects and their control.**
3) **Agricultural engineering.** E.g. soil and water conservation and farm machinery.
4) **SOIL science.** Study of soils.

Production. All activities that increases quality and quantity. E.g. Land preparation, planting, fertiliser application.

In animal, production includes; selection and breeding, parasites and diseases control.

BRANCHES OF AGRICULTURE.

Major branches are:

1) Crop production.
2) Livestock production.
3) Soil science.
4) Agricultural economics.
5) Agricultural engineering.

1) CROP FARMING (ARABLE FARMING)

Arable farming is production of crops on cultivated land (monocropping/pure stands and mixed stands/intercropping)

a) Field crops.

Crops grown in fairly large area of land. Include annuals such as pulses and Cereals or perennial.

b) Horticultural crops.

These are perishable crops.

Entails:

- **Floriculture.** Growing of flowers such as roses, carnations, lilies, chrysanthemums tuberose etc.
- **Olericulture.** Growing of vegetables such as cabbages, tomatoes, onions and French beans.
- **Pomology.** Growing of fruits such as Avocados, piers and citrus.

2) Livestock farming.

a) Pastoralism (mammalian livestock farming)

Pastoralism. Practice of rearing farm animals on pastures. Includes animals such as cattle, goats and sheep.

b) Fish farming/aquaculture.

Rearing of fish and other aquatic animals in fish ponds.

c) Apiculture.

Rearing of Bees in structures called beehives.

d) Poultry keeping.

Poultry are birds kept for production of eggs and meat.

3) Agricultural economics.

Branch of agriculture that deals with utilisation of scarce resources. Aims at maximising output while minimising cost.

4) Agricultural engineering.

Deals with use and maintenance of farm tools, machinery and structures.

Farming systems.

Organisation of the farm and all the enterprises in relationships to each other.

Extensive system.

Characteristics.

- Requires large tract of land.
- Low capital investment.
- Low labour per unit area.
- Low yields per unit area.

Intensive system.

Characteristics.

5) Requires high capital and labour investment per unit area. High yields per unit area.

Large scale farming.

- Involves use of large tracks of land.
- Requires heavy capital investment and skilled labour.
- Requires high level of management
- Operation cost per unit area of production is low.

Includes:

Plantation farming and ranching

a) **Plantation farming.**

Growing of one type of crop in a large area

b) **Ranching.**

Keeping of beef animals in marginal areas.

The livestock carrying capacity is low due to limited pastures.

Small scale farming.

Farming carried out on a small area of land less than five hectares.

Advantages.

- Requires low capital investment.
- Possible where land is a limiting factor.

Disadvantages.

- Uneconomical to mechanise due to small size.
- Low production.
- Difficult to specialise.
- Labour intensive.

Methods of farming.

A method of farming is an established way of carrying out farming activities. Includes.

1) Mixed farming.
2) Nomadic pastoralism.
3) Shifting cultivation.
4) Organic farming.
5) Agroforestry.

- **Mixed farming.**

Entails growing of crops and rearing of animals on the same farm.

Advantages.

- Mutual benefit between crops and livestock.

- Acts as an insurance against total loss by the farmer.
- Maximum utilisation of resources.

- **Nomadic pastoralism.**

Pastoralism. Practice of rearing livestock on pastures.

Nomadic. Practice of moving from one place to another.

Nomadic pastoralism. Moving with animals from one place to another in search of pastures and water.

Advantages.

- Serves as backbone of beef industry in Kenya.
- Source of income to pastoral communities.
- Proper way of utilising arid and semi-arid areas.

Disadvantages.

- Encourages spread of livestock pests and diseases due to communal watering points, grazing and spraying points.
- Tendency of increased soil erosion and land degradation.
- Difficult to control breeding and breeding diseases.
- Low production of both meat and milk and hides and skins due to energy losses.
- Source of conflict and ethnic tension among the Nomadic communities for control of good pastures and water.

- **Shifting cultivation.**

Method of cultivating a piece of land until the soil is exhausted and then the piece is abandoned /left fallow.

Advantages.

- Land is allowed to rest and regain its fertility.
- No build- up of pests and diseases.
- Soil structure is restored.
- Cost of production is low since inorganic fertiliser and pesticides are not used.
- Crop produce is chemical free.

Disadvantages.

- Not applicable where land is a limiting factor.
- Farm planning and acquisition of credit is not possible.
- Lack of soil conservation measures.

- Not possible to grow perennial crops.
- Low output per unit area due to poor farming methods.
- Where fire is used to clear land organic matter is lost.

Applicability.

- Where land is communally owned.
- In large tracts of land. Where population is scarce.
- Where number of livestock per unit area is low.

- **Organic farming.**

Farming method where crops are grown and livestock reared without use of agrochemicals.

Advantages.

- Cheap and cost effective.
- Useful in improving soil structure.
- No environmental pollution.

- **Agroforestry.**

Practice of integrating trees and crops on the same piece of land. Trees selected should have the following characteristics:

- Able to grow fast.
- Deep rooted to minimise competition for nutrients.
- Should be preferably leguminous.

Examples.

Causurina equisetifolia

Grevillea robusta

Sesbania sesban

Cajanus cajan

Advantages.

- Important sources of wood and timber.
- Maximum utilisation of land.

- Trees helps to control soil erosion.
- Some are used as livestock fodder.
- Leguminous trees add nutrients into the soil thus improving soil fertility.

IMPORTANCE OF AGRICULTURE TO THE ECONOMY.

1) **Source of food.**

To meet the nutritional requirements and to enable man to engage in other activities.

2) **Employment.**

Provides direct employment as farm labourers and indirectly e.g. working in agricultural based industries.

3) **Source of raw materials.**

For industries e.g. cotton lint for textile industry.

4) **Source of market.**

For industrial goods e.g. farm tools and equipment, pesticides etc.

5) **Source of foreign exchange.**

Through exporting agricultural produce, the country earns foreign exchange.

6) **Source of income.**

Farmers as well as the government get revenue from the sale of agricultural produce and tax payment.

CHAPTER TWO.

FACTORS INFLUENCING AGRICULTURE.

These are:

- Human factors.
- Biotic factors.
- Climatic factors.
- Edaphic factors.

Human factors.

Human characteristics that affect decision making and operations carried out..

Includes.

- Level of education and technology.
- Human health/HIV-AIDS.
- Economy.
- Transport and communication.
- Government policy.
- Cultural and religious beliefs.
- Market forces.

Human health/HIV-AIDS.

Effects of HIV-AIDS.

- Shortage of farm labor.
- Loss of family support.
- Low living standards leading to despondency and hopelessness.
- Time wasted looking after the sick and money used to buy drugs instead of farm inputs.

Government policy.

Are government laws enacted to protect farmers, land and livestock.

Includes:

- Food policy.
- Policies on control of livestock parasites and diseases.
- Policy on marketing of farm produce.

Policies by the government that helps improve agricultural production.

- Heavy taxation of imports in order to protect local industries. This makes importation more expensive and discourage sale of products similar to those produced locally.
- Subsidizing the growing of locally produced commodities. This makes production cheap and affordable to most farmers. E.g. reducing tax on inputs to make them cheaper to buy and use.
- Quality control. This ensures production of high quality goods for both export and domestic market.
- Conservation of natural resources. To make them sustain agriculture. E.g. conservation of forests, water catchment areas, wildlife and soil.
- Stepping up control of diseases and parasites that affect crops and livestock. Such measures includes: quarantine, licensing of quality products and vaccination of animals against infectious and contagious diseases.

Level of education and technology.

Low level of education results in farmers using poor methods of farming. They tend to rely on fate, superstitions and traditions.

Knowledge in mathematics helps in measurements and calculations leading to accuracy in apply inputs and assessing results. It is necessary for proper accounting and analysis leading to proper decision making.

Knowledge in science helps in observation, interpretation and solving problems.

What can be achieved with this high level of education and technology?

- Proper method and time of doing things such as planting at the proper time and spacing.
- Use of the right type and amount of inputs.
- Applying the inputs at the right place. E.g. foliar fertilizers on the leaves.
- Making right decisions based on proper observation. It helps for example, in observing signs of disease and applying the right treatment or fertilizers.

High level of education leads to:

- Accuracy in applying inputs and assessing results
- Helps in proper decision making and organization
- Better problem solution
- Better utilization of livestock feeds and fertilizers
- Understanding of technical language used in agriculture
- Development of skills for operating machines and their maintenance
- Increase in efficiency and minimizes costs

Biotic factors.

Living organisms that affect agricultural production.

They include:

- Pests.
- Pollinators.
- Parasites.
- Pathogens.
- Predators.
- Nitrogen fixing bacteria.

Pests.

Destructive organisms. They cause the following.

- Lowers the quality and quantity of agricultural produce.
- They transmit crop diseases. Pests with sucking mouthparts feed on sap and in the process they transmit crop diseases especially viral diseases.
- Some injure the plant parts which they feed on and as a result expose the plant to secondary infection. They may also lead to rotting of produce.
- They increases the cost of producing crops. This is because control measures have to be undertaken such as chemical control which is expensive.

Parasites.

Invertebrates which live in or on other living organisms. (Endoparasites and Ectoparasites.)

They suck blood from the animals and irritate them by biting on their skin.

Decomposers.

Micro-organisms that act on plant and animal remains. They lead to decomposition thus adding organic matter to the soil.

Predators.

Animals that kill and feed on other animals. Predators that feed on pests are beneficial to farmers as they reduce pest populations.

Pathogens.

Micro-organisms that transmit diseases. They cause death of plants and livestock. They reduce both the quality and quantity of agricultural products. Include: bacteria, viruses and fungi.

Pollinators.

Can be insects or birds. They lead to cross pollination which helps in the production of new and improved varieties of crops. Include: bees, butterflies.

Nitrogen fixing bacteria.

Found in the nodules of leguminous crops roots. Convert nitrogen from air into nitrates. Their presence in soil make soil more fertile when leguminous crops are grown.

Climatic factors.

Include:

- Rainfall.
- Temperature.
- Relative humidity.
- Wind.
- Light.

Weather. Atmospheric conditions of a place at a given period of time.

Climate. Weather condition of a place observed and recorded for a period of 30-40 years.

Rainfall.

Water is required by the plants for the following reasons:

- Acts as a solvent for plant nutrients.
- Cools the plant during transpiration.
- Raw material for photosynthesis.
- Makes plant turgid hence providing support.

Plant responses to lack of adequate water.

- Closing stomata to reduce water loss.
- Hastens maturity.
- Some will roll their leaves.

Aspects of rainfall.

1) **Rainfall reliability.**

It is the dependency on the meteorological timing on the onset of the rains. It determines time for land preparation and planting.

2) **Rainfall amount.**

Quantity of rainfall that falls in a given area within a given year measured in millimeters

It determines the type of crops to grow and type of livestock reared in an area.

3) **Rainfall distribution.**

Refers to the number of wet months in a year. Influences the choice of crop varieties grown in an area. Annual rainfall indicates the amount of rainfall available during the year though it does not tell about how it is spread throughout the year.

4) **Rainfall intensity.**

Amount of rain that falls in an area within a period of one hour and is measured in MM per hour. Rainfall of high intensity damage crops and causes soil erosion.

Temperature.

The hotness or coldness of a place measured in degrees Celsius or centigrade

Topography is the surface feature of an area and it affects the temperatures of a place.

Effects of temperatures on crop production.

Low temperatures.

- Slows growth rate of crops as the process of photosynthesis is slowed.
- High incidences of disease infection to crops such as Elgon die back, CBD and hot and cold diseases of coffee.
- Quality of some crops such as tea and pyrethrum improves with the lowering of temperatures.

High temperatures.

- Increases evaporation leading to wilting of crops.
- Increase rate of growth or hastens maturity of a crop.
- Improves the quality of some crops such as pineapples and oranges.
- Increases incidence of disease infection and pest attack in crops. For example, leaf lust in coffee and aphids in vegetables.

Ecological zone.	**Range of altitude.**	**Livestock.**	**Crops.**
High altitude. (high potential)	2100 m and above.	❖ Exotic dairy breeds of cattle and wool sheep breeds. ❖ Exotic beef breeds.	Tea, pyrethrum and high altitude maize varieties.
Medium altitude. (High to medium potential.)	1500-2100m	❖ Exotic dual-purpose breeds. (boran and sahiwal) ❖ Exotic dairy breeds such as Guernsey and jersey. ❖ Dairy goats.	Coffee, maize hybrids of medium altitude, bananas and beans.
Low altitude. (Low potential.)	900-1500m	Zebu cattle, meat goats.	Katumani maize, bananas, sorghum, pigeon peas, cassava.

Wind.

Refers to air in motion.

Effects of strong wind in agriculture.

- Increasing the rate of evaporation of moisture from the soil.
- Causing lodging in cereals and damage to crops.
- Blowing away and bringing rain-bearing clouds.
- Acting as agent of seed dispersal.
- Acting as agent of soil erosion.
- Increasing evaporation rate.
- Increasing the spreading of pests and diseases.
- Destroying farm structures.
- Areas with high humidity tend to be hotter but when wind takes away atmospheric water, a cooling effect occurs.

Relative humidity.

It is the amount of water vapor held by air at a given temperature, compared to what it would hold when saturated. It affects the rate of evaporation and transpiration.

Evaporation is the loss of water from the soil surface in form of water vapor while transpiration is the loss of water vapor through the leaf pores. At high relative humidity, the rate of evapotranspiration is low.

Light.

Light provides the energy required for photosynthesis.

Aspects of light.

1) **Light intensity.**

Strength with which light is harnessed by chlorophyll for the purpose of photosynthesis. Rate of photosynthesis increases with increase in light intensity. Low light intensity makes plants especially seedlings to become etiolated (thin and pale in colour).

Ways of increasing amount of light harnessed by crops.

- Pruning.
- Thinning.
- Weeding.
- Use of a wider spacing.

2) **Light duration.**

Refers to the period during which light is available to plants per day.

Photo periodism. Plant response to light duration.

- **Short-day plants.** Requires less than 12 hours of day light to flower and seed. E.g. soya beans, rice and tobacco.
- **Long-day plants.** Requires more than 12 hours of daylight to flower and seed. For example; some wheat varieties.
- **Day-neutral plants.** Requires 12 hours day light to flower and seed. Include tropical plants like; coffee, maize and beans.

3) **Light wavelength.**

Chlorophyll absorbs certain wavelength of light which are not present in artificial light unless incase of ultra-violet or infra-red.

- Green houses or Glass houses can be used to control temperatures, relative humidity and light intensity and duration.

EDAPHIC FACTORS.

Soil is the natural material on the uppermost layer of the earth's crust which support plant growth. Consist of a mixture of weathered rock and decayed organic matter. Supports plant's life by providing anchorage, nutrients and water.

Soil formation.

Soil is formed through weathering process. Weathering is the breakdown and alteration of the parent rock near the earth's surface.

A series of complex changes occur and alter the form, colour, texture and composition of rocks.

Weathering is a combination of disintegration (breakdown down process) and synthesis (building up process.) Weathering is brought about by physical, biological and chemical processes.

Soil forming factors.

- Climate.
- Parent materials.
- Living organisms.
- Topography.
- Time.

Physical agents of weathering.

These includes: wind, water, moving ice and temperatures.

- Strong winds carry materials which hit against each other making surfaces of the materials break off into smaller fragments.

- When rocks or other materials are moved along the ground, they have a grinding effect.
- Moving ice also has a grinding effect.
- Rainfall of high intensity erodes rock surfaces.
- In places of high altitude, the temperatures are low and when water gets into cracks, it freezes and become ice. This increases the volume of water by 9%. The increase in volume exerts pressure on the walls of the cracks in the rocks widening them and dislodging mineral grains from small fragments.
- In arid and semi-arid areas, temperatures are very high during the day. This makes the rocks to expand starting from the outside to the inside. At night, temperatures drop. This makes the rocks to cool and contract starting from the surface. This unequal expansion and contraction of the rocks causes the outside part of the rocks to flake off.
- This physical or mechanical weathering in time causes the disintegration of rocks without any chemical changes being involved.

Biological agents of weathering.

Living organisms play a very important role in soil formation.

- When large animals such as elephants, buffaloes, cattle, horses, camel and man move, they exert pressure on the rocks causing the small fragments to disintegrate.
- Man's activities like mining, earth moving, cultivation and construction of buildings, railways and roads reduce the size of the rocks into smaller particles.
- Bacteria and fungi initiate the breakdown of plant tissue on the surface and within the soil. Organisms such as ants' termites are also important in tropical soil formation.
- Termites bring to the surface large quantities of fine materials. This promotes weathering as lower materials become aerated.
- Earthworms feed on plant tissues and their waste matter helps to cement soil particles.
- Roots of growing vegetation force their way into cracks on the rocks exerting pressure which eventually splits the rocks. When the plants die, the roots decay leaving gaps in rocks which are then occupied by water and air that forms acids that dissolve minerals from rocks and corrode rocks weakening them.
- Roots produce acids in the soil during respiration, which dissolves minerals from rocks.

Chemical weathering.

- It is the actual decay or decomposition of rocks. Involves various chemical reactions which take place between rock minerals, water and certain atmospheric gases like oxygen and carbon(iv) oxide.
- The chief agent of chemical weathering is water.
- As rain water falls through the atmosphere, it dissolves some carbon iv oxide forming very weak carbonic acid. This acid reacts with the mineral particles of the rocks particularly calcium carbonate causing decomposition.

Rain water + carbon (iv) oxide= weak carbonic acid.

$H_2O + CO_2 \longrightarrow H_2CO_3$

Weak carbonic acid + limestone $\longrightarrow$ calcium bicarbonate.

$H_2CO_3 + CaCO_3 \longrightarrow Ca(HCO_3)_2$

- The calcium bicarbonate formed is soluble in water and this process dissolves the rocks.
- Oxygen reacts with many elements such as iron from olivine rocks forming ferrous and ferric oxides that produces red soils.

Factors influencing soil formation.

Parent rock material.

- Influence physical properties and chemical constituents of the soil.
- Texture of the soil affects rates of soil formation. Freely drained parent materials form soils faster than dense impermeable parent materials.
- Mineral composition of the soil depends on the nature of the parent material. Rocks containing calcite, feldspar and Ferro magnesium minerals are likely to produce deep heavy soils rich in plants nutrients.
- It influences the type of natural vegetation in an area.

Climate.

- Rainfall provides water which is an important reactant in all forms of weathering. The precipitation: evaporation ration is important. If precipitation exceeds evaporation, there will be loss of ions in drainage water. If surface evaporation

exceeds precipitation, there will be accumulation of salts either on the surface or within the soil profile.

- High temperatures speed up the rate of chemical reactions. In cold regions, chemical reactions are slow and activity of micro-organisms is also slow limiting soil formation.
- Wind acts as a transport agent and carries weathered materials from one place to another. Where a lot of weathered materials are deposited, soils are deep and where wind carries away the top soil, the soil remain shallow or bare rock is left.
- Dry areas have soils with carbonate accumulation in the profile.

Topography.

It is the shape of land in relation to the underlying rock of the earth's surface.

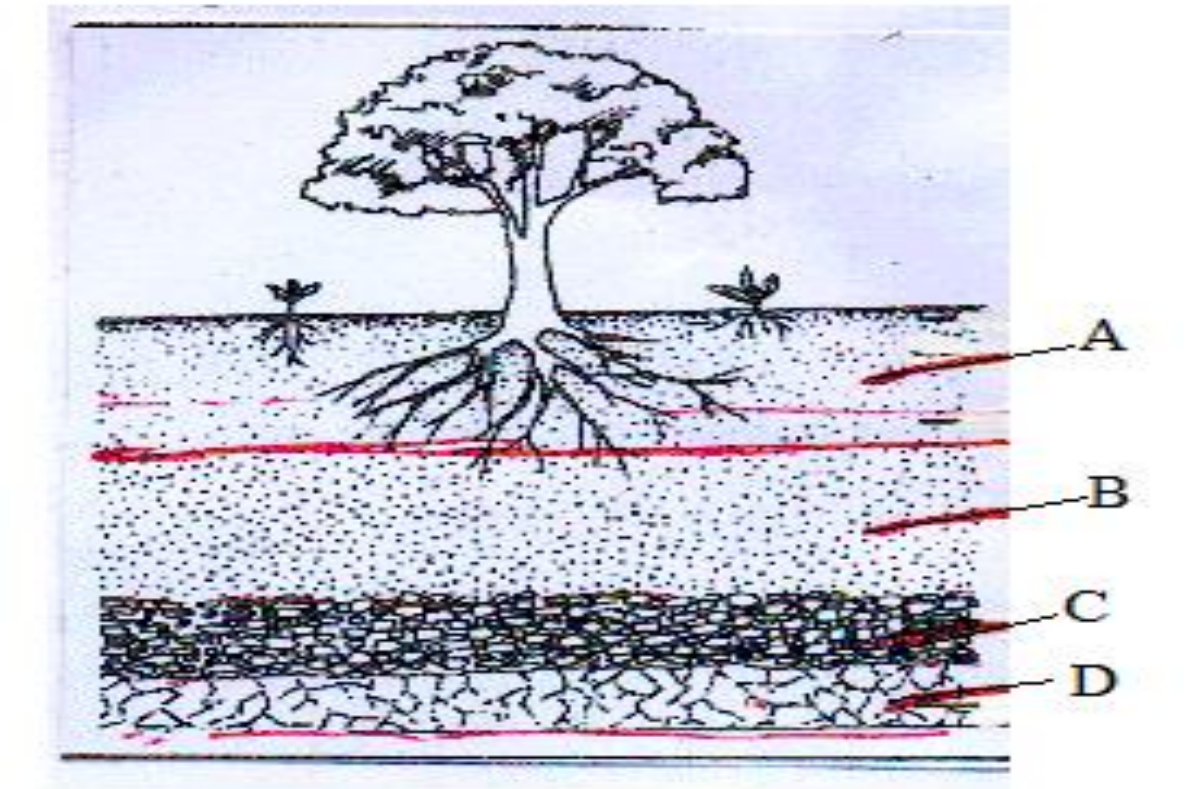
- Factors such as elevation, slope and degree of exposure or shelter may influence the degree of soil erosion.
- Slope affects the depth of the soil and kind of vegetation growing in an area. Soils found in flat land and low lying areas tend to be more fertile than those on higher slopes.
- On steep slopes there is soil erosion that leads to shallow soils.
- In flatter areas, there are deeper soils that are richer in minerals due to deposition. The soils tend to be darker in colour and well drained.

Time.

- Where soil forming process have taken place over a long period, deep mature soils can be found.
- Where erosion has been severe there is a tendency of soil to remain shallow and youthful with a poorly differentiated profile.
- In flatter areas, soil erosion is less and this makes the time factor have a greater effect on the soil, giving rise to mature soils. If parent material is not easily weathered, it may take a long time for soil to grow to maturity and develop in depth.

SOIL PROFILE.

Vertical arrangement of various soil layers/horizon.



1) **Superficial layer.**

Thin layer consisting of dry decaying and decayed origin matter covering the soil's surface.

2) **Top soil (Horizon A)**

Uppermost soil layer.

- Darker in colour than other layers due to its high humus content.
- It is well aerated and contains active micro-organisms.
- Well drained and contains most of the plant nutrients.

3) **Sub-soil. (Horizon B)**
   - More compact and less aerated than the top soil.
   - Hardpan which is an impervious layer may be found in this region. Hard pan impedes drainage and root penetration.
   - Downward movement of clay colloids are deposited in this region hence called layer of accumulation.

4) **Substratum/weathered rock. (Horizon C)**
   - Made of partly weathered rock with no humus.
   - It is hard and impervious to water.
   - Roots of large trees may reach this layer to draw water in dry season.

5) **Parent rock. (Horizon D)**
- Called the bedrock.
- Soil is formed from this rock.
- Ponds of water are also found here.

- A transitional zone is found between any two bordering soil layers which reflects properties of adjoin horizons.

Differences between soil formed in situ and soil formed in deposition.

Soil formed in situ.	**Soil formed in deposition.**
• Shallower.	• Deeper.
• Less rich in plant nutrients.	• Picher in plant nutrients.
• Easily eroded.	• Not easily eroded.
• Has the colour and characteristics of the parent rock.	• Has the characteristics of where it came from.
• Less silty.	• More silty.
• Has the same chemical composition as that of underlying parent rock.	• Differs in chemical composition from the underlying parent rock.

Soil depth. Distance between top soil layer and the bottom soil layer in a soil profile.

- ❖ Deep soils are suitable for crop growth since they contain more nutrients.
- ❖ Deep soils facilitate good drainage and aeration.
- ❖ Deep soils have larger surface area for root expansion.
- ❖ Loosely packed sub-soil allows easy penetration of roots, drainage and aeration. This ensures soil erosion does not take place.
- ❖ Nature and composition of bedrock influences mineral components of the whole soil.

SOIL CONSTITUENTS

Soil is made up of the following:

1. Mineral matter
2. Soil water
3. Soil air
4. Organic matter
5. Living organisms

1. Mineral matter

These are inorganic compounds formed from the weathering of rocks. They differ in size ranging from clay to gravel. They include:

- Clay
- Silt
- Sand
- Gravel

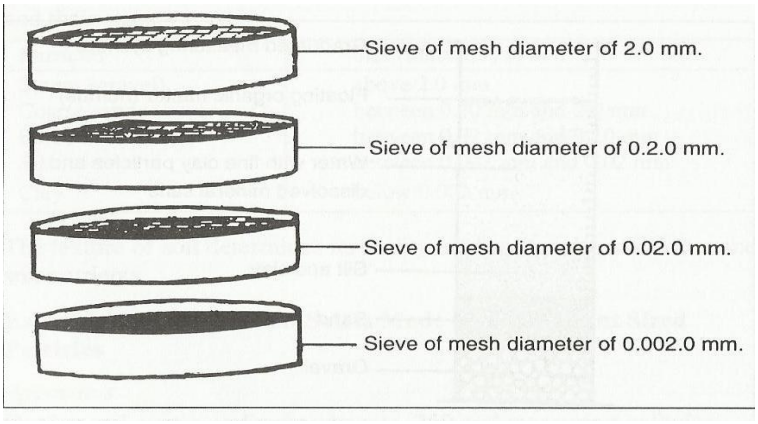
Influence of mineral particles on crop production

They make the main frame work of the soil

They hold plant roots firmly together

How to determine the mechanical composition of the soil

Using various sieves of different diameter



2. Soil water

Soil has water which comes from rainfall and also from irrigation in dry lands

Forms of soil water

- Superfluous water
- Capillary water
- Hygroscopic water

Superfluous water

- This is water which is held by gravity. It is also called gravity water.
- Its easily lost because its loosely held by soil particles
- Its readily available to plants but not useful because too much of it limits aeration

Capillary water

- This is water occupying the micro pores. It is held by soil particles
- It's the water available to plants. It is also referred to as available water

Hygroscopic water

This is water which forms a thin film around the particles. It is not available to plants

Functions of water to plants

- Soil water maintains the life of plants
- It is used as a raw material for protein for diffusion of mineral salts and oxygen into the root hairs and the mineral salts dissolved in water are conducted upwards to the leaves.
- It is also acts as a solvent for the diffusion of other substances from one part of plant to another
- It makes protoplasm and cell sap of the growing plants
- It keeps the cell turgid and thus supports plant
- Also cools the leaves of the plant during transpiration

Experiment 1 to find the percentage of soil water content

Apparatus: - dish, stirring, weighing balance, soil sample and heater or oven

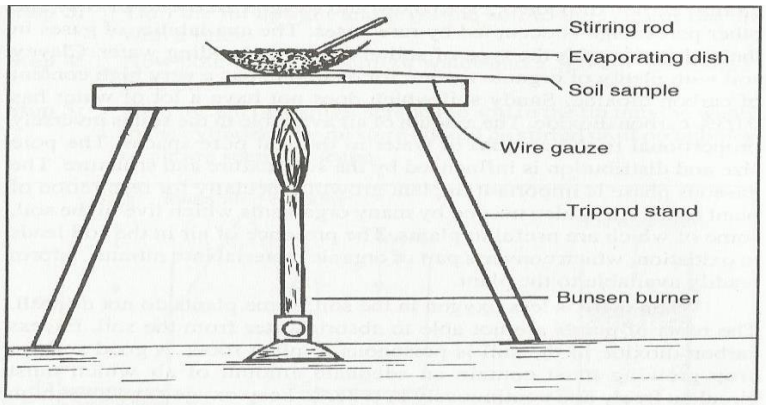


Fig 2.8: To find the percentage of total water content of soil

Mass of fresh soil only = (x+y–x) = yg
Mass of dish + dried soil = (x+z)g.
Mass of dried soil only = (x+z–x) = zg
Mass of water driven off = (y–z)g
Percentage of water by mass

$$= \frac{\text{Mass of moisture}}{\text{Mass of fresh soil}} \times 100 = \frac{(y-z)}{y} \times 100$$

Procedure:

- Measure the mass of the dish
- Pour soil in the dish and weigh
- Half fill the dish with water
- Heat up to about $105^{o}c$
- Cool the sol with a desiccator then reweigh and repeat the process until you get a constant mass

3. Soil air

The spaces between the soil particles are filled with air. These include

Oxygen ---------- 20.6

Carbon dioxide ------- 0.6

Nitrogen ---------- 78.6

Other rare gases.

The amount of air available in the soil is inversely proportional to the amount of water in the soil pore spaces.

Oxygen present in the air is essential for the respiration of roots and other living organisms in the soil

Nitrogen in the soil is converted into nitrates by the nitrogen fixing bacteria

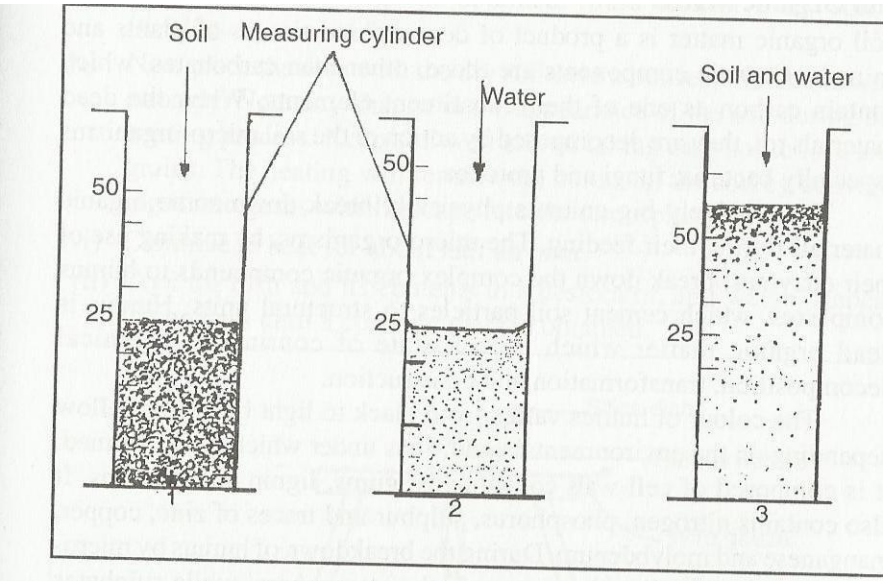
Air is also needed by the micro- organisms living in the soil

Excess carbon dioxide in the soil is poisonous to plants

Experiment 2: To find the percentage of air by volume in a soil

Apparatus

- Small tin
- Graduated cylinder
- Knife and stirring rod



Procedure

- Turn the empty tin upside down and press firmly into the ground until the tin is completely filled with soil
- Turn the tin upright and level the soil to the brim of the tin with a ruler
- Pour 250cm^3 of water into a cylinder and scrap off soil into the water until no bubbles comes out
- Record the final volume of soil and cylinder

4. Soil organic matter

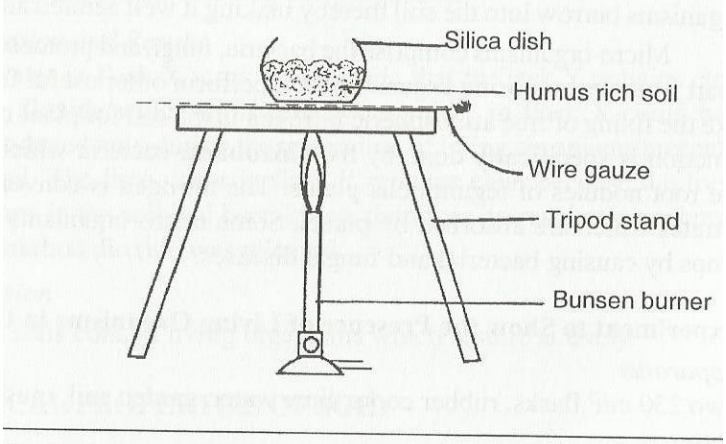
- Organic matter in the soil is the remains of the dead plants and animals plus their waste products
- Humus is the decayed organic matter

Importance of organic matter

- Decomposes to release nutrients to plants
- Makes the soil lighter to cultivate
- Also improves the soil structure

Experiment 3: To find the % of humus content in the soil

- Apparatus
- Dish
- Garden soil
- Tripod stand
- Wire gauze
- Bunsen burner



To find percentage of humus content

Procedure

- Weigh the empty dish
- Put the garden in the dish and reweigh
- Place in an oven at about $105^{o}c$
- Cool in a desiccator and reweigh
- Repeat the process several times until a constant weight is obtained
- Note the difference weight

5. Soil living organisms

There are two types of living organisms in the soil namely:

- Macro organisms
- Micro organisms

Macro organisms are large organisms found in the soil e.g. rodents, earthworms, ants, termites, plant roots etc.

Microorganisms are tiny organisms which can only be seen with the help of a microscope they include bacteria, fungi, protozoa etc.

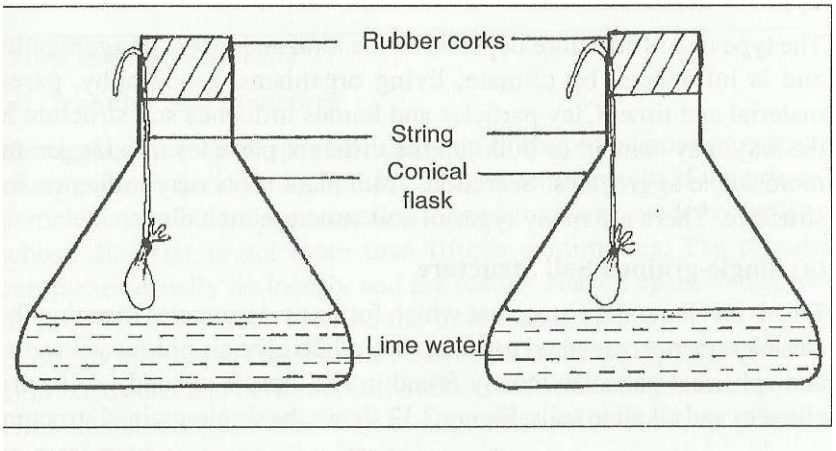
Importance of soil living organisms

- They barrow in the soil and aerate the soil and improve drainage
- They help in the decomposition of organic matter
- Some also fix nitrogen in the soil e.g. the nitrogen fixing bacteria

Experiment 4: To show the presence of living organisms in a soil sample

Apparatus

- 2 flasks
- Rubber cork
- Muslin bag
- Heater
- Lime water
- Garden soil



Procedure

- Put a handful of garden soil in two muslin bags labeled A and B
- Heat the soil in muslin bag B strongly to kill the micro organisms
- Suspend the two bags in the flasks also labeled A and B, the flasks should contain lime water
- Leave the apparatus for 4hrs

Observation

- Lime water in flask A turns milky
- Lime water in flask B remains clear

Conclusion

- Lime water in flask A turns milky because of the presence of carbon dioxide produced during respiration. Carbon dioxide turns lime water milky
- Lime water in flask B remained clear since the living organisms were killed during heating so no respiration took place

Physical properties of soil

These include:

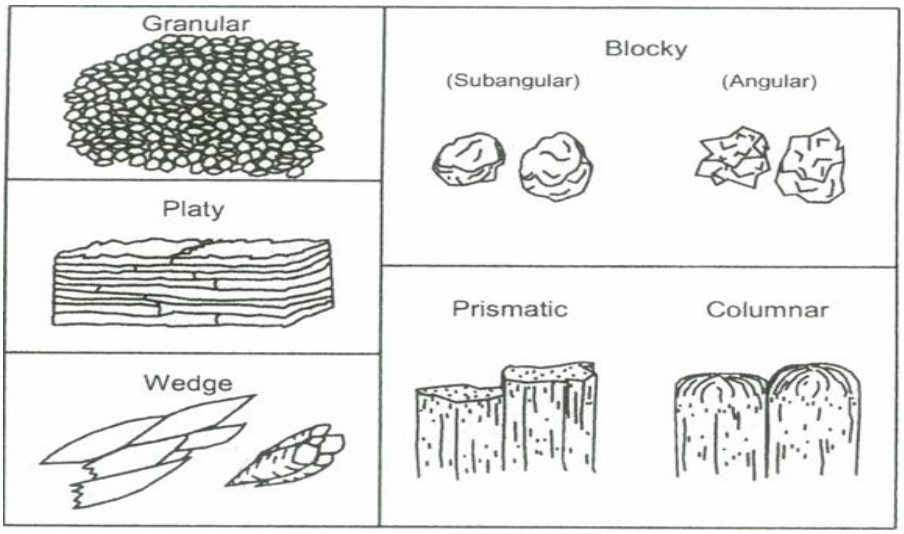
1. Soil structure
2. Soil texture
3. Soil colour

1. Soil structure

This is the way in which the individual soil particles are arranged

Types of soil structure

(a) Single grained structure
(b) Crumby structure
(c) Granular structure
(d) Platy structure
(e) Blocky structure



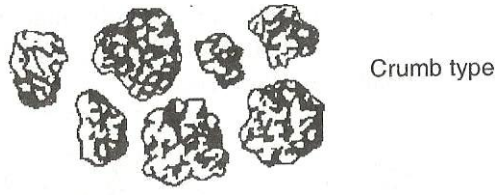
(a) Single grained structure

In this structure, the particles are not cemented together. They exist as individual grain. They form no aggregates and are non-porous.

They are mostly found in top soils of sandy soils and in arid climate and in alkaline soils

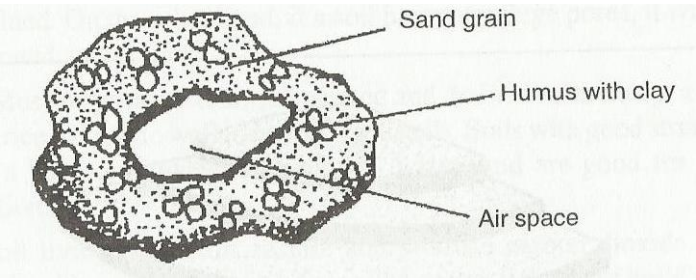
(b) Crumby structure

This type consists of small, soft porous aggregates of irregular shapes. They are not closely fitted together



(c) Granular structure

This is made of friable rounded aggregates of irregular shapes called granules. It is formed when particles coagulate and are cemented together to form rounded aggregates whose diameter is not more than 15cm



When wet it becomes porous since the spaces are not readily closed by swelling. The structure is found in top horizon in cultivated soils and in the sub- soil under grass. The structure is not porous and is usually affected by tillage.

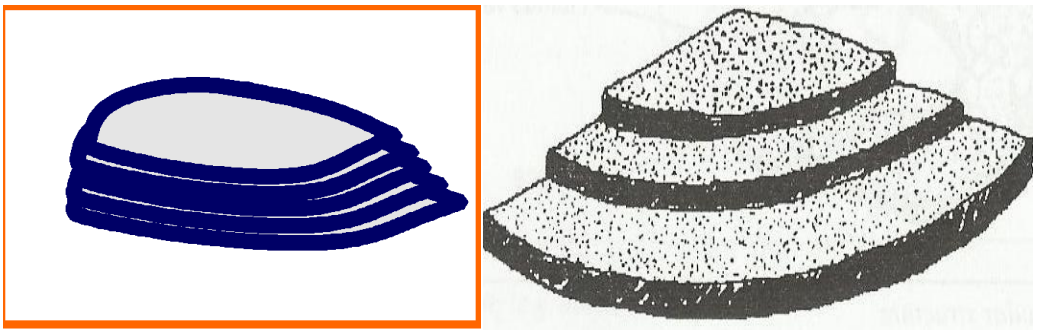
(d) Prismatic structure

This is where the structure aggregates are arranged vertically. The primary particles are vertically oriented forming distinct columns which vary in length depending on the type of soil.

The structure is found in sub soil of arid and semi arid soils

N/B: If the tops are rounded, they are called **columnar.** But if the tops have clear cut edges, the it is called **Prismatic**

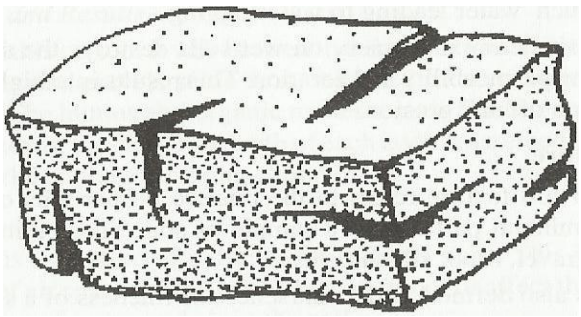
(e) Platy soil structure



In this structure, the aggregates are arranged on top of one another on thin horizontal plates. The plates overlaps and impair permeability and hence drainage and root penetration. The structure is found in top soils of clay soil and forested area.

(f) Blocky structure

Here the aggregates are in form of rectangular blocks. The aggregates easily fit together a long vertical edges



Influence of soil structure on crop production

- A loosely packed structure ensures good air circulation in the soil

- Good structure also ensures proper water holding capacity
- Good structure also gives proper root anchorage
- Good structure also reduces then soils liability to erosion

Factors that influence the soil structure

a) Parent material

The physical and chemical properties of the parent rock will determine the type of structure being formed

b) Soil forming processes

Processes which lead to soil formation will determine the type of structure being formed

c) Climate

In areas where a lot of rainfall is followed by dry periods cracks tend to form giving rise to good structure which is well aerated

d) Organic matter

Presence of organic will stabilize the soil structure

e) Living organisms

Living organisms also help to decompose organic matter which intern improve structure

f) Cultivation

The nature of cultivation e.g. digging channels results in a better structure

g) Inorganic compounds

Presence of compounds like iron oxide have binding properties and help in the formation of granules

2. Soil texture

This refers to the relative proportion of various sizes of mineral particles in a soil.

Particles	**Diameter**
• Clay	0.002mm and below
• Silt	0.002 ------ 0.02
• Fine sand	0.02 ------- 0.2
• Coarse sand	0.2 -------- 2mm

- Gravel 2 ---------- 20mm
- Stone 20mm and above

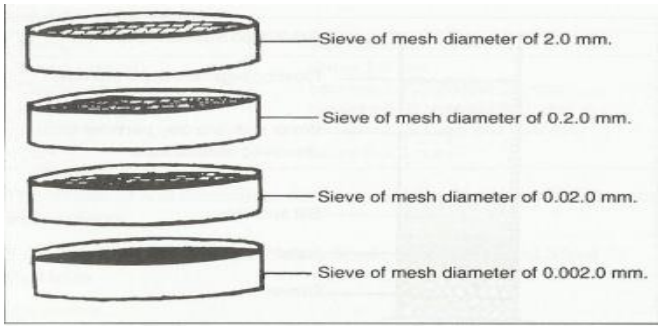
Determination of soil texture

Can be determined by:

- Mechanical analysis
- Chemical analysis

Mechanical determination of soil texture

Apparatus



- Sieves of different diameter
- Containers
- Weighing balance

Procedure

- Put a known amount of soil sample in a container
- Pass the soil through a sieve of the smallest diameter and shake
- Weigh the soil that remains in the sieve
- Repeat the process using sieves of different diameter until all the soil I passed through

Observation

After every sieving it will be observed that a certain amount of soil remains in the sieve

Conclusion

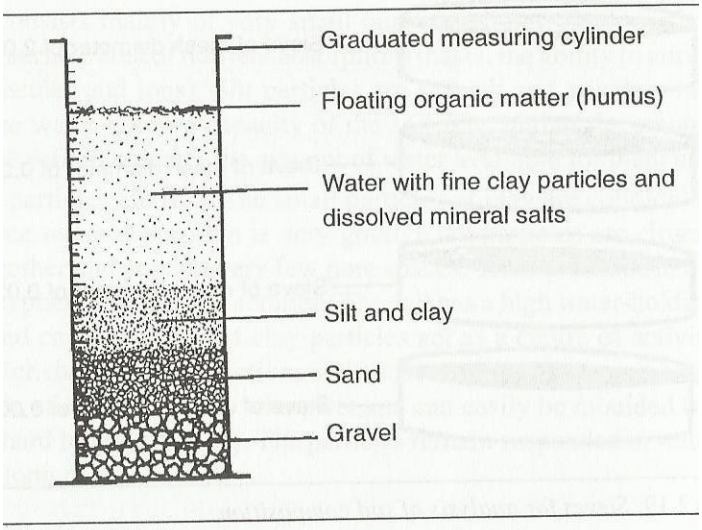
Soil is made up of different sized particles of different diameter

Experiment 6: to show that soil is made up of different sized particles

Apparatus

- Measuring cylinder

- Sodium carbonate
- **Garden soil**



Separation of soil particles

Procedure

- Put some soil sample in a measuring cylinder
- Add about 4 times its volume of water with sodium carbonate to aid in dispersion of particles
- Cover the mouth of the cylinder with the hand and shake vigorously for about 2min.
- Place cylinder on the bench for about 1hr or more to allow the contents to settle down

Observation

- At the end of the period, it will be seen that fractions have settled in layers
- The heavy, coarse gravels settle first, then followed in succession by sand, silt and clay
- The humus and organic matter remain floating in the water or on top of the clay

Conclusion

From the above observations, it can then be concluded that soil is a mixture of particles of different sizes.

Influence of soil texture on crop production

- Coarse soils have poor water holding capacity
- Very fine textured soils also have poor aeration

Soil colour

- Soil colour depends mainly on the mineral composition of the soil
- If the soil was made from a rock containing a lot of iron compounds, it tends to be brownish yellow, reddish or orange in colour
- Humus content also gives dark brown colour

- Soil colour influences temperature of the soil

Soil classification

Soil can be classified based on the following

- Soil structure
- Soil texture
- Soil colour
- Soil pH

According to structure, soils could be classified as granular, crumby, blocky, or platy soil structures

According to texture, a soil containing high proportion of sand particles is called **sandy soils**, if it contains high amount of clay then it is called **clay soils**

In terms of colour, soils could be either dark coloured soils or light coloured soils

Types of soils

1. Sandy soils
2. Silty soils
3. Clay soils
4. Clay loams
5. Loamy soils

1. Sandy soils

- They have bigger particles
- Contains 50 - 80% sand, and 20 -50% silt and clay
- Organic matter content is 0.1 - 3%
- Are well drained
- Are more prone to soil erosion have low water holding capacity
- They are slightly acidic
- Easy to cultivate but less fertile

How to improve sandy sols

- Add organic matter
- Addition of fertilizers

2. Silty loams

- They contain 20 – 30% sand
- Also contains 70 – 30% clay

- Has 0.1 - 4% organic matter
- They are fine textured, well drained and have a good water holding capacity
- They have moderately acidic pH.
- Moderately fertile and aerated

3. Clay loams

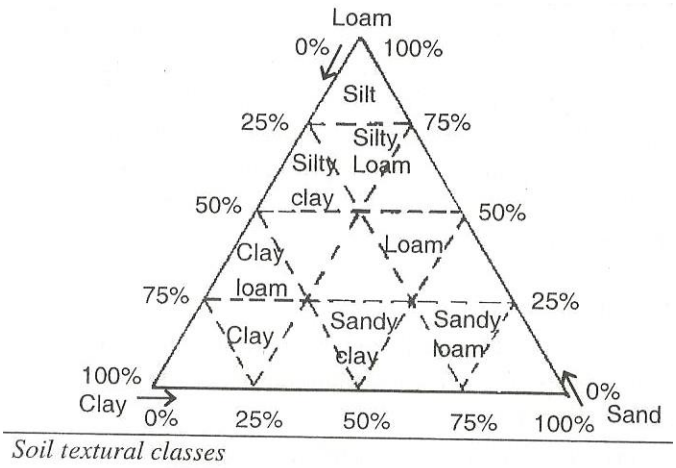
- They contain 20 - 50% sand
- Clay and silt is 20 -60%
- Has organic matter content of 0.1 - 6%
- They are fine textured
- Poorly drained and aerated
- Has capillarity and water retention
- They are rich in plant nutrients
- Are suitable for flood irrigation for rice growing
- This soil can be improved through drainage

4. Clayey soils

- Have clay content of more than 40%
- Have high water holding capacity
- Have crystalline and platy structure
- Expand when wet
- Crack when dry
- Get water logged easily
- Also suitable for flood irrigation
- Have high capillarity

5. Loamy soils

- They contain 30 -50% sand, 50 -70% silt and clay and 0.4% organic matter
- Are moderately textured and drained
- Are slightly acidic
- Have good water holding capacity
- Can be improved by planting cover crops and adding organic manures

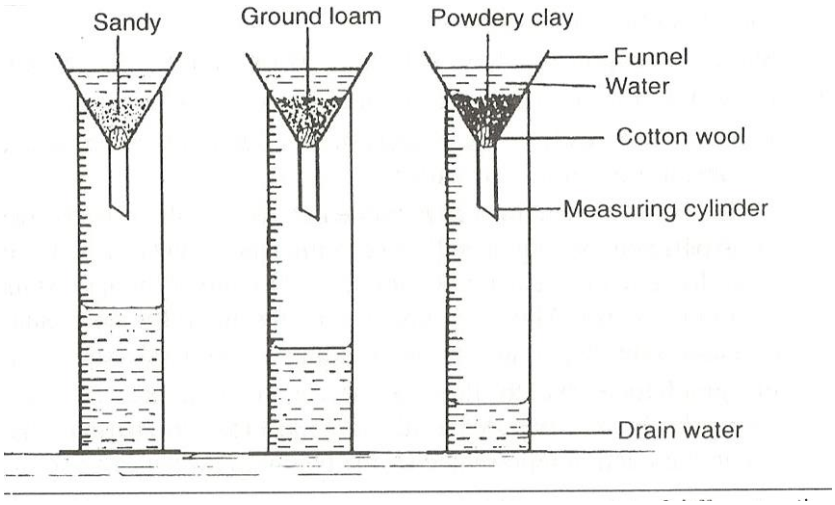


Soil textural classes

Experiment 7: To compare the porosity and water holding capacity of sand, loam and clay

Apparatus

- Measuring cylinder
- Funnels
- Cotton wool
- Dry sand, loam and clay



Procedure

- Place equal volumes of each soil in each funnel plugged with cotton wool
- Tap all the funnels persistently until all visible air spaces are filled up
- Stand each funnel in the open end of measuring cylinder and add 50cm^3 of water into each funnel
- Note the time taken for the first drop of water through into the cylinder

Observation

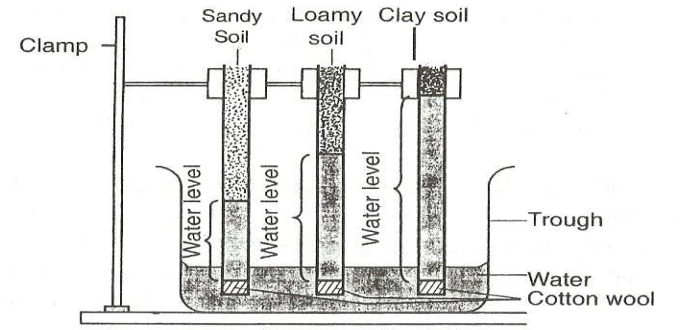
After some time, it will be seen that water level is high in sand than the rest

Conclusion

Sandy soil is more porous than the other 2

Clay soil has the highest water holding than the other 2

Experiment 8: To compare the capillarity of sand, loam and clay
Apparatus
3 long cylinders
Dry sand, clay and loam
Water trough
Clock
Ruler



To compare capillarity action in different soils

Procedure

- Close the lower end of each tube with a plug of cotton
- Fill each tube with different soils
- Tap the end of each tube gently in the bench to tightly pack the soils
- Stand and clamp each tube with a clamp and put in an empty water trough
- Poor water into the trough to a depth of 5cm
- Measure the height of water in each tube after 3 – 5min
- Take as many readings as much as possible
- Record the readings

Observations

- Water will be seen to be rising up the tubes
- It rises very fast in sand and loam in the first 3 – 5min. but very slow in clay
- After 2hrs water level will be higher in loam than in clay soil and least in sand
- Water rise continues in clay soil but stops after some time in loam

Conclusions

- Clay and loam have higher capillary action due to their fine pore spaces
- Sand has poor capillary action due to their large pore spaces
- Clay soil has the highest capillarity

Chemical properties of soil

1. Soil pH
2. Soil mineral content

1. Soil pH

- This is the acidity or alkalinity of soil solution
- Acidity is determined by hydrogen ion concentration while alkalinity is determined by hydroxyl ion concentration

Influence of soil pH on crop production

- Soil pH affects the availability of various nutrients e.g. low pH makes P, and molybdenum less available and high pH. makes Mn, K, Fe and zinc less available
- Very low pH affects the activities of microorganisms e.g. nitrogen fixing bacteria
- Different crop species require different pH ranges

Ways of modifying pH

- Apply lime to raise the pH
- Apply basic fertilizers
- Apply sulphur to lower the pH
- Apply acidic fertilizers to lower the PH

CHAPTER THREE.
FARM TOOLS AND EQUIPMENTS.

Introduction

- Farm tools and equipment perform specific jobs in the farm.
- They make work easier and more efficient.
- They can be classified according to their uses as follows:

Garden Tools and Equipment

Tools	Uses
Panga	Cutting and shallow cultivation, making holes.
Jembe/hand hoe	Cultivation, digging, shallow planting holes and trenches.
Fork iembe	Cultivation, digging out roots, harvesting of root crops.
Rake	Collecting trash, breaking large clods, levelling, removing from a seedbed and spreading organic manure.
Spade	Scooping and carrying of soil, sand, concrete mixture and manure.
Spring balance	Measuring weight.
Trowel	Scooping seedlings during transplanting and .digging planting holes for seedlings.
Pruning hook	Bending tall branches when pruning.
Secateur	Cutting young stems and pruning branches.
10. Tape measure	Measuring distances.
11. Axe	Cutting big trees and roots and splitting logs of wood.
12. Soil auger	Making holes for fencing posts.
13. mattock	Digging hard soils
14. sprinklers	Overhead irrigation.
15. Watering can	Watering plants in nursery bed.
16. Wheel barrow	Transportation of soil, fertilizers, farm produce, tools and
17. Levelling board	For levelling a nursery bed.
18. Pruning saw	Cutting old wood stems and pruning big branches.
19. Hose pipe	For conveying water from a tap to where it is need.
20. Knap sack sprayer	Applying agro-chemical by spraying.
21. Garden shear	Trimming hedges.
22. Pruning knife	Removal of small shoots.
23. Meter ruler	Measuring distances.
24. Garden fork	Shallow digging.

Livestock production tools and equipments.

Tools	Uses
Drenching gun	Administering liquid drugs to animals orally.
Bolus gun/dosing	Administering solid drugs or tablets to animals orally.
Wool Shears	Cutting off wool from sheep.
Hypodermic syringe	Administering drugs by injection for example in vaccination.
Stirrup (bucket)	Application of acaricide by hand spraying.
Thermometer	Taking body temperatures of farm animals.
Burdizzo	Used in bloodless method of castration.
Halter	Rope designed to restrain the animal.
Trimming knife	Cutting short the overgrown hooves.
Elastrator	Stretching rubber ring during castration, dehorning and of lambs.
Iron dehorner	Applies heat on the horn bud to prevent growth of horns.
Nose ring	Fixed into the nose of a bull to restrain it.
Strip cup	Detecting mastitis in milk products.
Trocar and cannula	Relieving a bloated animal of gases particularly ruminants.
Hard broom	For scrubbing the floor.
Ear notcher	Making ear notches in livestock.
Bucket	For holding milk during milking.
Milk chum	For holding milk after milking.
Milk strainer/sieve	Removing foreign particles from milk for example hairs and
Rope	Tying or tethering animals.
Milking stool	Used by the milker to sit on while milking.
Weighing balance	Weighing milk after milking.
Teeth clipper	Removal of canine teeth of piglets soon after birth.
Chaff cutter	Cutting fodder into small bits.
Dehorning wire	Cutting grown horns.

Workshop Tools and Equipment

Tools	Uses
Spanner	Tightening and loosening nuts and bolts.
Pliers	Cutting small wires and thin metal and gripping
Files	Sharpening tools, smoothening or shaping edges of
Rasps	Smoothening and shaping of wooden
Chisels (wood)	Making grooves in
Cold chisel	Cutting and shaping
Screw drivers Saws Cross cut saw Rip saw Hack saw Bow saw Tenon back saw Coping saw Compass/keyhole Tin snip	Driving screws in or out of wood or metal. Cutting across the grain of wood. Cutting along the grain of wood. Cutting metals. Cutting branches of Cutting Joints on wood and fine sawing. Cutting curves on thin wood. Cutting either along or across the grain of wood When cutting key Cutting metal sheets.
Braces and bits.	Boring holes in wood.
Drill and bits	Boring holes in metal work and woodwork.
Hammer	
Claw hammer	Driving in, removing and straightening nails.
Ball pein Mallet	Driving in nails, rivets and straightening metal. Also on cold chisel Hammering or hitting wood chisel.
Jack plane	Fine finishing of wood.
Scrappers/spokesha	Smoothening curved surfaces of wood such as
 Measuring	jembes, axes.
Metre ruler Try square Marking gauge	Measuring short length Measuring length angles and to ascertain squareness. Marking parallel lines to the edge of wood.
Fencing pliers	Cutting wires, hammering staples when
Vice and clamps	Firmly holding pieces of work together.

Tools	Uses

Spirit level	Measuring horizontal or vertical levels.
Soldering gun	Melting soldering rods when repairing or fabricating sheets.
Wire brush	Brushing rough surfaces.
Divider	Marking and laying out.
Centre punch	Marking the point of drilling.
Paint brush	Applying paint on surfaces.
Sledge hammer	Ramming hardware, breaking stones.
Wire strainer	Tightening wires during fencing.
Riveting machine	Fix rivets when joining pieces of metal.
Claw bar	Removing long nails from wood, straining fencing digging fencing holes.

Plumbing and Masonry Tools

Tools	Uses
Pipe wrench	Holding, tightening and loosing metallic pipes.
Pipe cutter	Cutting PVC pipes.
Levelling rod	Levelling the floor during construction.
Mason's trowel	Placing mortar between construction stones and
Wood float	Create a level surface on walls and floors.
Mason's square	Ascertain verticalness.
Plumb bob	Spreading screed over floors and walls.
Shovel	Mixing and scooping concrete or mortar, measuring

Care and Maintenance of Tools and Equipment

Reasons for Maintenance

- To increase durability.
- To increase efficiency.
- Reduce costs of replacement.
- For safety of the user/avoid accidents.
- Avoid damage to the tool.

Methods

- Use tools for the right work.
- Proper handling when using tools or equipment.
- Clean and oil tools after work.
- Keep tools in there right place.
- Replace and repair worn-out parts

- Sharpen cutting or digging edges
- Grease moving parts to reduce friction
- Use safety devices in the workshop to reduce accidents and breakages

TOOL

A tool is any instrument held in the hand and used to do work

EQUIPMENT

This is something used for specific purpose

Why farmers use tools and equipment

- To increase efficiency
- To make farm operations easier
- To minimize injuries
- To enhance production

Precautions in handling tools and equipment

- Proper maintenance
- Proper use of tools
- Proper storage
- Use safety devices and clothing
- Proper dressing
- Skilful handling of tools

Categories of farm tools and equipment

1. Garden tools and equipment
2. Livestock production tools and equipment
3. Workshop tools and equipment
4. Plumbing tools and equipment
5. Masonry tools and equipment

Factors determining the choice of tools to use

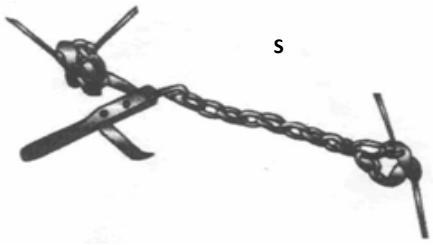
- The task to be performed
- The tools efficiency
- The level of knowledge and skill of user
- Availability of the tools

General maintenance practices of farm tools

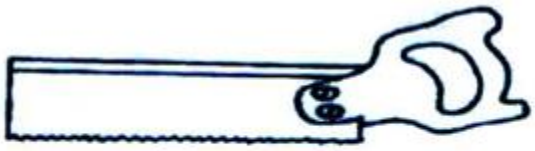
- Sharpen the cutting edge
- Grease the moving parts
- Repair or replace worn out parts
- Proper and safe storage
- Clean after use
- Tighten loose nut and bolts
- Oil and paint before long storage

Reasons for maintaining farm tools and equipment

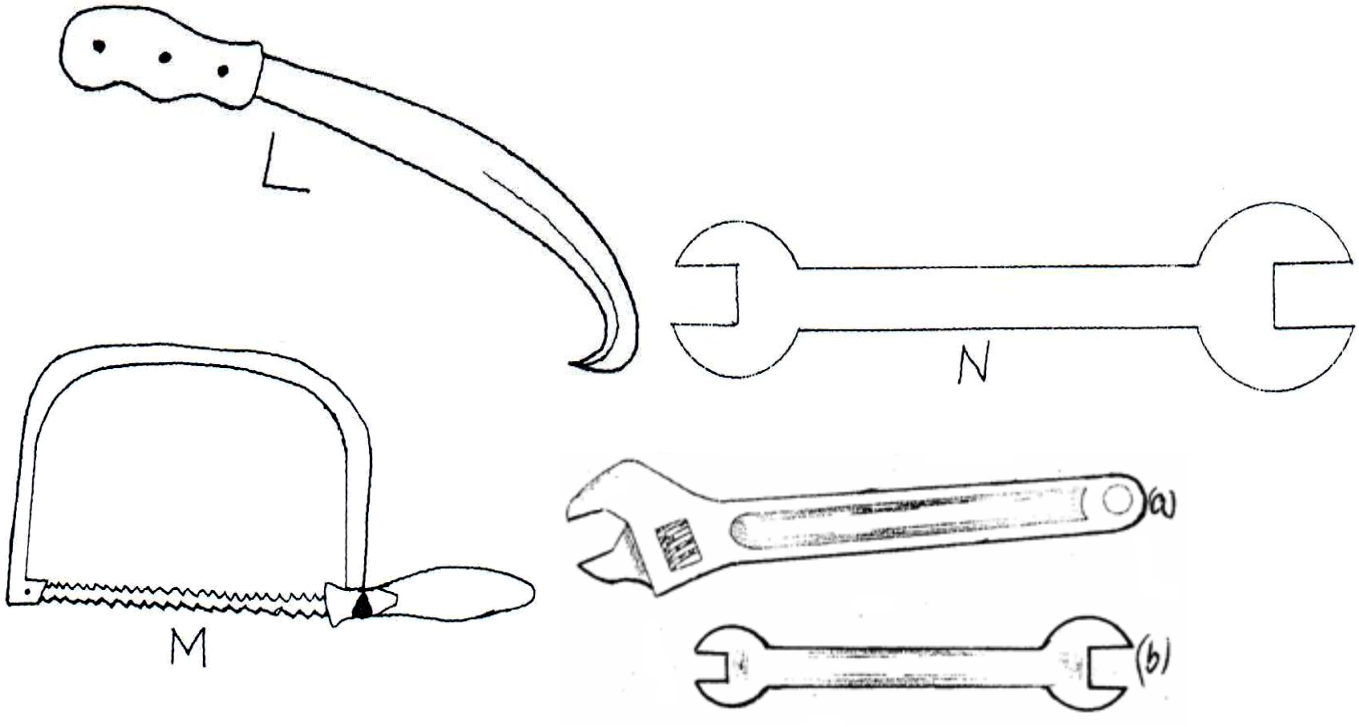
- To increase lifespan / durability
- To improve efficiency
- To avoid injury
- Reduce production cost

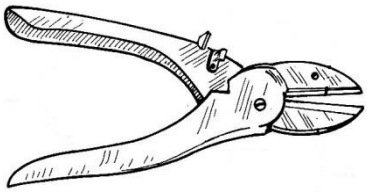


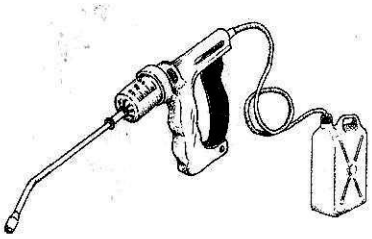
A

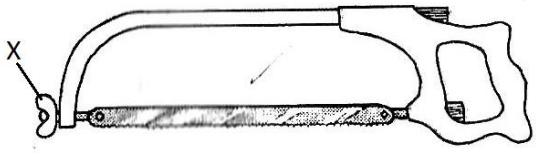


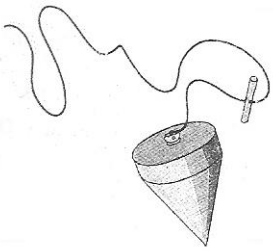
B

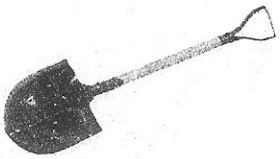

L
N
M
(a)
(b)

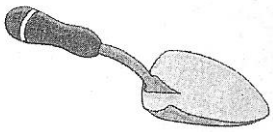


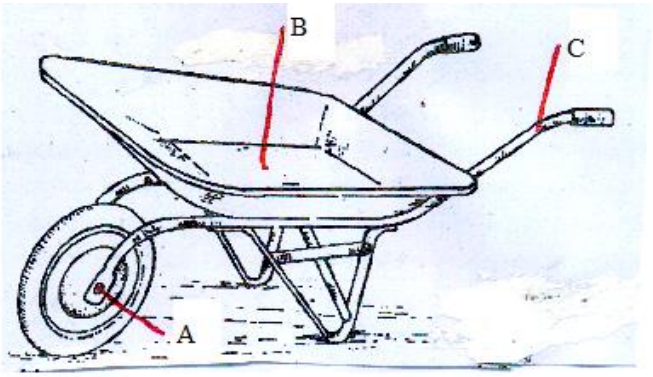



X

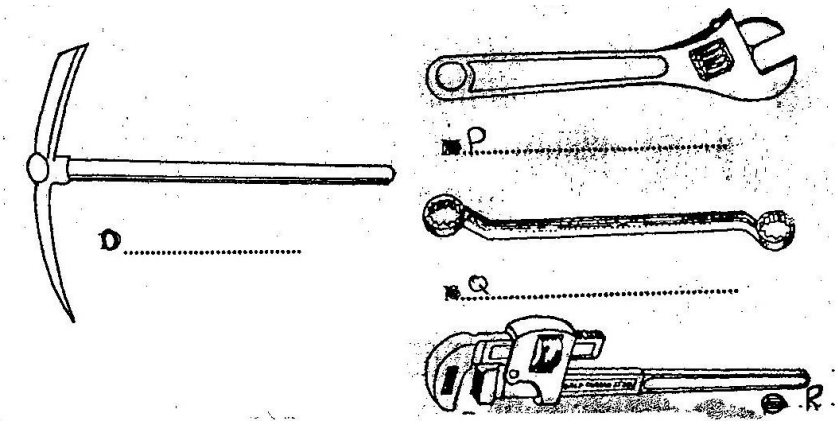


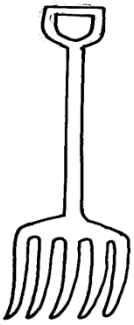




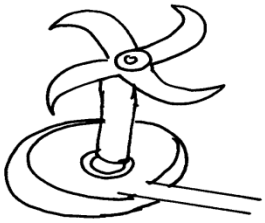

B
C
A


K

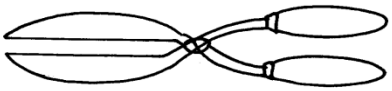




K

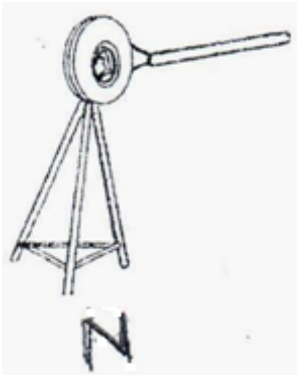


M

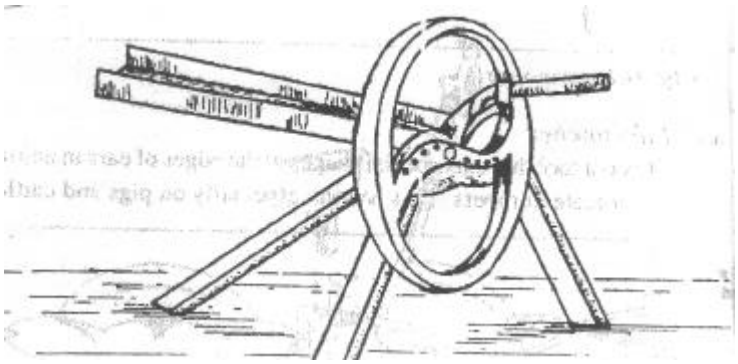


L

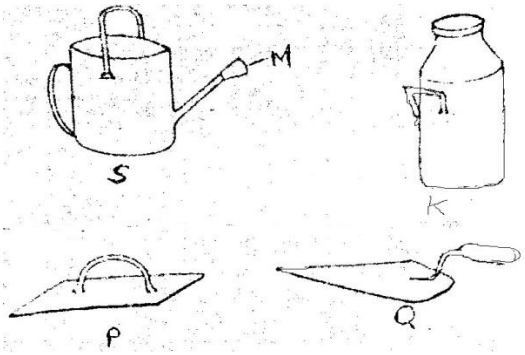
N

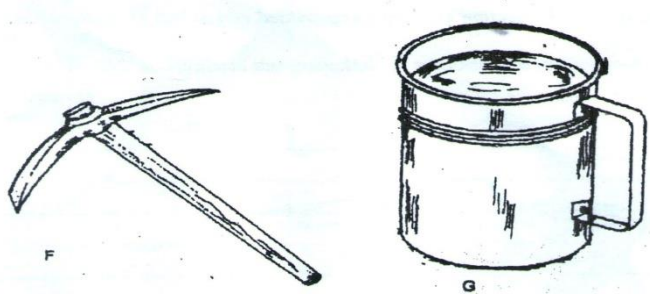


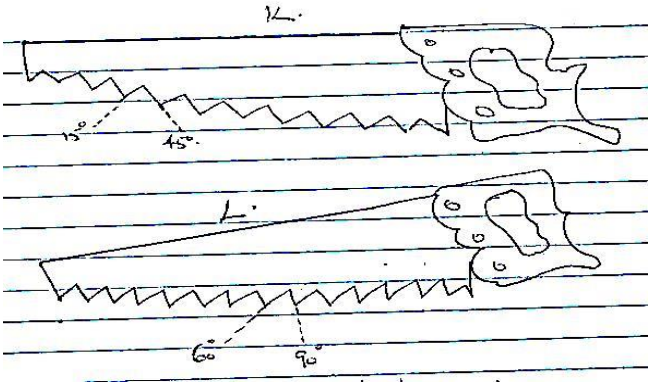
N

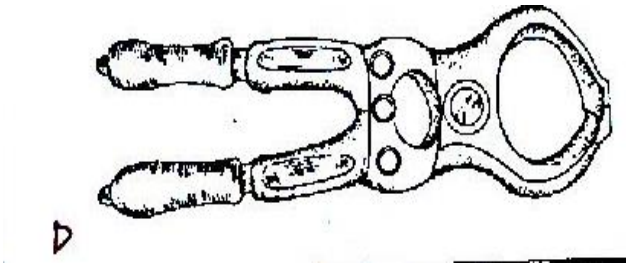


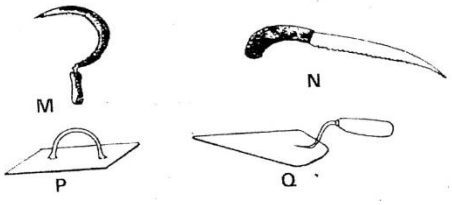

1
2
3
4
5

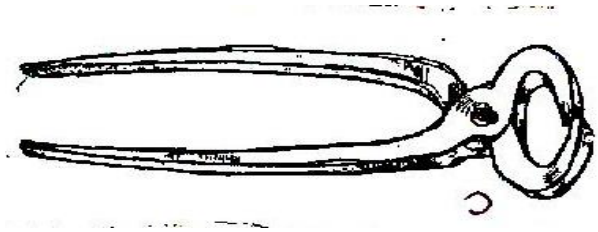

M
S
K
P
Q

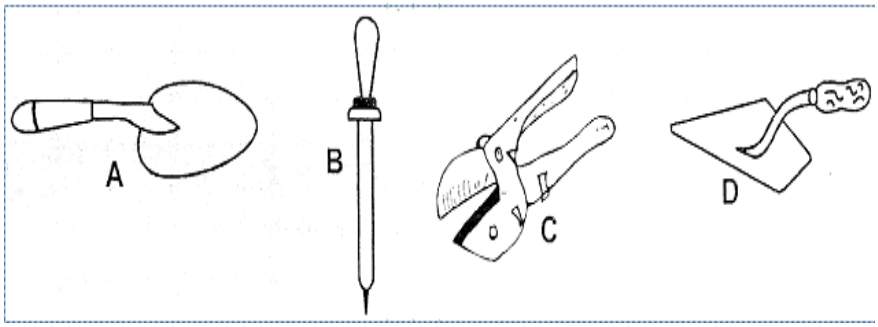

F
G

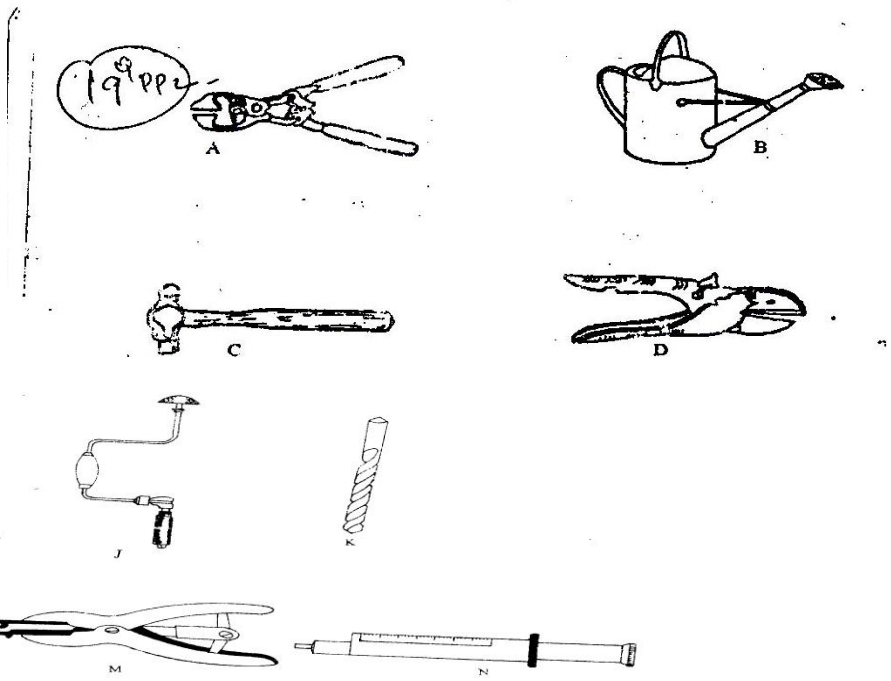

K
15°
45°
L
60°
90°

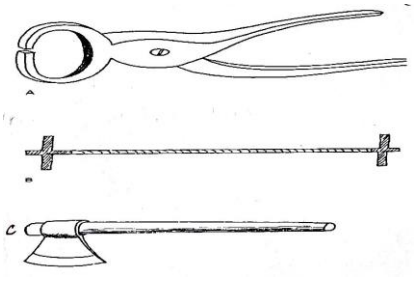

D


M
N
P
Q


C


A
B
C
D


A
B
C
D
J
K
M
N



CHAPTER FOUR.
CROP PRODUCTION 1:
(LAND PREPARATION.)

Land preparation.

- All activities that makes land suitable for planting.

Involves ploughing or digging, harrowing, ridging and rolling.

Importance of land preparation.

i. To kill weeds.
ii. To incorporate manure and other organic matter into the soil.
iii. To destroy different stages of crop pests such as eggs, larvae, pupae or adults by burying them, exposing them to heat of the sun and predators and starving them.
iv. To aerate the soil.
v. To encourage the penetration of roots in the soil.
vi. To make subsequent operations possible. Such operations include; planting, fertilizer application, rolling and ridging.
vii. To encourage water infiltration.

Operations in land preparation.

A. Land clearing.

It is the removal of vegetation cover from the surface before land is tilled.

It is a method of land reclamation.

Conditions under which land clearing is necessary.

i. When opening up a virgin land.
ii. Where a stalk growing crop was previously planted.
iii. Where the interval between primary and secondary cultivation is long such that land has reverted to its original virgin state.
iv. Where land was left fallow for a long time.

Methods of land clearing.

i. Tree felling.

Involves cutting down of trees. Axes, pangas and small power saws are used in small scale. Bulldozers and root rakers are sued on large scale. Destumping/removal of stumps and disposal of trash follows.

ii. Burning.

The bush should be burned when the speed of wind is low to avoid possible spread of fire to other fields. It destroys a lot of organic matter, soil microorganisms and plant nutrients.

iii. Slashing.

Small bushes and grasses can be cleared by this method. A slasher or a panga is used in small scale. For large scale a mower is used.

iv. Use of herbicides.

These chemicals kills weeds faster and more easily.

B. Primary cultivation.

- It is the initial opening of the land either after clearing the bush or following a previous crop.
- Hand digging is done using jembe or fork jembe. In large scale, moldboard and disc plough are sued.
- Primary cultivation is done well before the onset of rains to give time for all operations to be done in good time.

Importance of primary cultivation.

i. To remove weeds.
ii. To bury organic matter for easy decomposition.
iii. To facilitate water infiltration and aeration.
iv. To destroy soil-borne pests by exposing them to predators and sun.
v. To make planting easy.

Ways in which primary cultivation is achieved.

i. Hand digging.

Use of simple hand tools such as jembes, mattocks and fork-jembes to cut and turn the soil slices.

ii. Mechanical cultivation.

Use of tractor-mounted implements such as moldboard and disc ploughs. Subsoilers and rippers to break hardpans.

iii. Use of ox-plough.

It is faster and more efficient than hand digging. Common where the terrain is fairly flat.

- **Aspects to observe in primary cultivation.**

1) Time of cultivation.

- Land should be prepared well before the onset of rains to give weeds and other vegetation enough time to dry up and decompose.
- Early cultivation also allows carbon (iv) oxide and other gases to diffuse out of the soil.
- It also gives enough time for other subsequent operations to be done thus ensuring early planting.

2) Depth of cultivation.

Factors determining depth of cultivation.

i. Type of crop to be planted.

Deep-rooted crops requires a soil that has been cultivated deeply. It facilitates esay root penetration.

ii. The implements available.

Some cannot cut soil beyond a certain depth. Such implements can be sharpened or weight added on them to make them plough deeper.

iii. The type of soil.

Heavy soils are hard particularly when dry. Simple hand tools will dig shallowly on such hard soils.

3) Choice of correct implements.

Determined by:

i. The condition of the land.

- If land has a lot of stones and stumps, it si advisable to choose a disc plough which does not easily break on such land.

- A jembe cannot work efficiently on a land which has a lot of couch grass as it does not pull out all the rhizomes. In such a case a fork-jembe is more efficient.

ii. The type of tilth required.

A very fine tilth requires the use of different ty.es of implements.

iii. The depth of cultivation.

- Heavy implements are necessary when deep cultivation is needed. Light implements are required when shallow cultivation is required.
- Cultivate the field during the dry season when the soils are friable.
- Very dry soils are difficult to penetrate with simple implements.
- Very wet soils may lead to development of hardpans.

C. Secondary cultivation/harrowing.

Operations that follows the primary cultivation.

- Seedbed refinement practices before planting.

In order to produce a fine tilt, small scale farmers' uses simple implements such as pangas, jembes or fork-jembes and garden rakes to cut the soil clods and then pulverize the soil. Harrows such as disc, spike toothed and spring tine are used in large scale.

Factors determining the number of times secondary cultivation is done.

i. **Size of the planting materials.** Big seeds requires a fairly rough seedbed, while small ones requires a fine one.
ii. **Slope of the land.** On hilly land, very fine seedbed could encourage soil erosion thus reduce the number of secondary operations.
iii. **The moisture content of the soil.** In dry soils, less operations are preferred so as to conserve the available moisture.
iv. **Condition of the land after primary cultivation.** Where there is plenty of trash, more secondary operations are carried out to incorporate most of the trash in the soil.

Importance of secondary cultivation.

i. To remove any weeds that might have germinated immediately after primary cultivation.
ii. To break the soil into small pieces for easy planting.
iii. To level the field in order to achieve a uniform depth of planting.
iv. To incorporate organic matter into the soil in order to encourage decomposition before planting.

D. Tertiary operations.

- Operations carried out to suit production of certain crops. Includes:

i. Ridging.

Process of digging soil in a continuous line and heaping it on one side to form a bund (ridge) and a furrow.

Importance.

- Encourage tuber expansion.
- Allows easy harvesting of root crops.
- Help to conserve soil and water in crops like sugar cane.

ii. Rolling.

Done to compact soil which is loose or of fine tilth.

Importance.

- Prevent small seeds from being carried away by wind.
- Prevents soil erosion.
- Increases seed-soil contact.

iii. Levelling.

Practice of making the soil surface flat and uniform so as to promote easy germination of small seeded crops. Facilitates uniform germination of seeds.

Sub-soiling.

Process of cultivating the soil for the purpose of breaking up the hardpans. Implements used for sub-soiling includes: sub-soilers, chisel plough and cultivators.

Importance of sub-soiling.

- Breaking hardpans.
- Facilitates adequate gaseous exchange.
- Bringing to the surface minerals which might have leached to the deeper layers.

Minimum tillage.

Application of a combination of framing practices aimed at least disturbance of the soil.

Farming practices involved in minimum tillage.

- Application of herbicides in controlling weeds.
- Use of mulch on the soil surface. Mulch prevents weeds from growing by smothering them.
- Restricting cultivation to the area where seeds are to be planted. Weeds in the rest of the field are controlled by slashing.
- Establishing a cover crop on the field.
- Uprooting or slashing weeds in perennial crops.

Reasons for carrying out minimum tillage.

1. **To reduce the cost of cultivation.** This is by reducing the number of operations.
2. **To control soil erosion.** Mulching and cover cropping greatly reduce chances of soil erosion.
3. **To maintain soil structure.** Continuous cultivation destroys soil structure hence it is avoided.
4. **To conserve moisture.** Continuous cultivation exposes the soil to the heat of the sun thus enhancing evaporation of available moisture.
5. **To prevent exposure of humus** to adverse conditions such as the sun's heat that causes volatilization of nitrogen.

CHAPTER FIVE.

WATER SUPPLY, IRRIGATION AND DRAINAGE.

WATER SUPPLY.

The hydrological cycle.

The circulation of water from the earth's surface to the atmosphere and back.

Sources of water.

Includes.

- Surfaces water sources.
- Ground water sources.
- Rain.
- **Surface water sources.**

Includes:

Rivers, streams, lakes and dams.

i. **Rivers, streams and dams.**

Rivers and streams originate from water catchment areas such as mountains, hills and forests.

To facilitate collecting of this water, weirs and dams are constructed to raise the water levels.

Weir.

Barrier constructed across the river to raise the water level and still allow the water to flow over it.

ii. **Dam.**

Barrier constructed across a river or a dry valley to hold water and raise its level to form a reservoir or a lake. However a dam has a spillway provision to allow excess water to flow away.

iii. **Lakes.**

These are huge collections of water on land depressions. Some lakes are salty and cannot be used for farming.

- **Underground water sources.**

Includes.

Springs, wells and boreholes.

i. **Springs.**

Water comes out of the ground as a result of an impervious layer meeting the ground surface. Later it collects into a stream. It should be fenced around to prevent contamination by animals. Spring water is less contaminated than rivers or lake water.

ii. Wells.

These are holes dug in the ground until the water table is reached. Wells should be dug during the dry season when the water table is very low. A reinforced concrete slab with a lockable lid should be constructed to prevent accidents, contamination and wearing of the topsides of the well.

iii. Boreholes.

These are deep holes drilled or sunk into the ground by the use of drilling machine sunk up to the parent rock. Special pumps are used to lift water out of the hole.

- **Rain water.**

Rain water is collected from rooftops and stored in tanks during the rainy season. Ponds can be dug to collect the runoff. Rainwater is the purest water compared to water from other sources.

WATER COLLECTION AND STORAGE.

Dams.

- They are constructed to collect and store water. The bottom part of the area behind the dam should have an impervious layer such as clay or rock to prevent water seepage.
- The embankment should be free from trees and bushes to prevent the roots from damaging it.
- Grass should be planted on the embankment to prevent soil erosion.

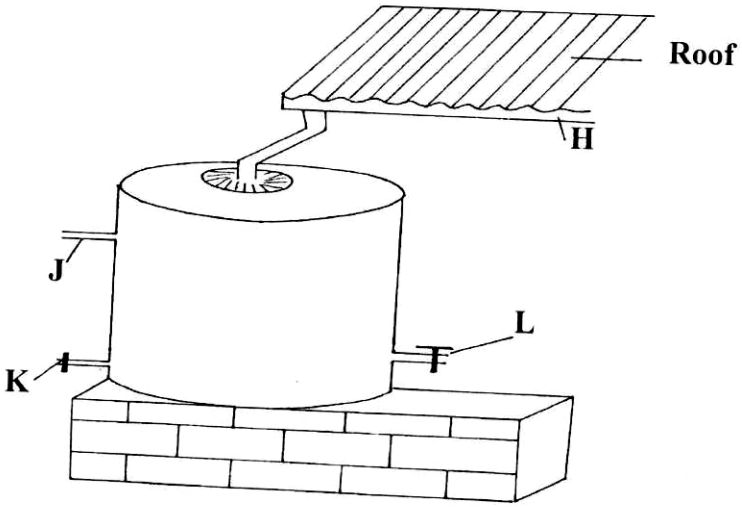
Weirs.

They are used to raise the water level in a river to facilitate pumping or flow by gravity.

Water tanks.

Made of concrete, stone, metal sheets, plastic or rubber.

They store water from rain or that which has been pumped. Tanks should be covered to prevent contamination from dust. Stone and concrete tanks should be reinforced with wire mesh or barbed wire during construction so as to resist water pressure.



Drums may be sued to store water but care should be taken to establish what these drums contained initially to avoid possible poisoning.

Pumps and pumping of water.

Pumping is the lifting of water from one point to another by use of mechanical force.

Water pumps.

i. **Centrifugal/rotardynamic pumps.**

These have metal discs with blades that rotate at high speed. Water is driven out by a centrifugal force to the outlet. They can pump large quantities of water. They are driven by petrol or diesel engine.

ii. Piston/reciprocating pumps.

Have pistons that move back and forth, thus pushing water through the pipes.

They do not pump a lot of water. Most are petrol/diesel driven or hand operated.

iii. Semi-rotary pumps.

Are used to pump water from wells by hands. They are manually operated and pump little amount of water mostly for domestic purposes.

iv. Hydram.

They are operated by the force of flowing water. The higher the speed of water, the greater the pressure created in the pump.

The limitation is that they cannot pump stationary water.

However, they pump water to considerable heights.

Conveyance of water.

This is the process of moving water from one point, mostly the source or point of storage, to where it will be used or stored.

Methods of conveying water.

- Piping.
- Use of containers.
- Use of canals.

Type and choice of pipes.

- **Metal pipes.**

There are two types of metal pipes.

i. **Galvanized iron pipes.**

Are heavy and suitable for permanent installations.

ii. **Aluminum pipes.**

Are light and are used in irrigation systems. Metal pipes are expensive but durable.

- **Plastic pipes.**

They are inexpensive and easy to install compared to metal pipes.

They are durable when properly installed.

Limitations of plastic pipes.

- They can burst under high pressure.
- They become brittle when exposed to the sun.
- They can be gnawed by rodents such as moles.

- **Hose pipes.**

They are two types of hose pipes. Plastic and rubber hose pipes.

Rubber hose pipes are more expensive but are more durable.

- **Use of containers.**

Water is drawn and put in containers such as drums, jerry cans, pots, gourds and buckets which are carried by animals, bicycles and human.

- **Use of canals.**

Water is conveyed from a high point to a lower along a gradual slope to avoid soil erosion. Such water is used for livestock and irrigation.

Water treatment.

Process of making it safe for use in the farm.

Importance of treating water.

i. To kill diseases causing micro-organisms such as cholera and typhoid bacteria that thrive in dirty water.
ii. To remove chemical impurities such as excess fluoride which may be harmful to human beings.
iii. To remove smells and bad taste. Smells and bad taste in water make it unfit for human consumption.

iv. To remove sediments of solid particles such as soil, sand and sticks. This makes water clear.

Process of water treatment.

- **Stage one: filtration at water intake.**
- ❖ Water leaves the source and pass through a series of sieves before entering intake pipe. Sieves have different size meshes. As raw water enters the pipe, large particles of particles of impurities are trapped by these sieves.
- **Stage two: softening of water.**
- ❖ Water flows into mixing chamber. This is a small tank where water circulates and is mixed with soda ash. And alum. Soda ash softens the water, while alum helps to coagulate solid particles which settle down to the bottom of sedimentation tank in stage three.
- **Stage three: coagulation and sedimentation.**
- ❖ The softened water moves to coagulation tank which is circular and large. Solid particles such as silt and sand settle down. The tank is also open to allow in fresh air into the water removing bad smells. Water should stay for at least 36 hours to kill bilharzia worms which cannot survive in stored for that long.
- **Stage 4: filtration.**
- ❖ Water with few impurities pass into filtration tank where all the reaming solid particles such silt are removed. Filtration tank has layers of different sizes of gravel and a top layer of sand. The layers allow water to seep through very slowly leaving all the solid particles behind.
- **Stage five: chlorination.**
- ❖ Filtered water enters chlorination tank. Small amount of chlorine solution is added. Flow of chlorine solution is controlled by a doser .the chlorine is used to kill micro-organisms in water.
- **Stage six: storage.**
- ❖ Water is stored before distribution. Should be out of bounds to unauthorized persons. It should be covered and the area around it well fenced.

Treatment of water by boiling.

In small-scale domestic, water is boiled to kill organisms that cause diseases such as bilharzia, cholera and typhoid. Boiling is expensive and can be done with small amounts especially for drinking.

General uses of water on the farm.

i. For domestic purposes such as washing utensils, cooking, drinking, washing clothes and cleaning the house.
ii. For watering livestock, washing animals for example, pigs, washing and cleaning livestock buildings and cleaning farm equipment.
iii. For diluting chemicals which are used in the control of pests and diseases in both crops and livestock.
iv. During the processing of farm produce such as coffee, carrots, beets, hide and skin.
v. In the construction of buildings, for example concrete mixing and curing.
vi. For irrigating crops especially during the dry season.

IRRIGATION.

It is the artificial application of water to soil for the purpose of supplying sufficient moisture to the crops. It is a method of land reclamation.

Conditions under which irrigation is applicable.

i. In dry areas.

These are areas that receive low amounts, insufficient for crop production. It is used as a method of land reclamation.

ii. During dry periods.

Some crops such as coffee, citrus, pineapples and other horticultural crops requires irrigation during the dry spell to meet their moisture requirements for high production.

iii. In the growing of paddy rice.

Paddy rice requires flooded conditions throughout the growing period.

Types of irrigation.

They include.

- Surface.
- Overhead.
- Sub-surface.

- Drip/trickle.

Factors determining the choice of irrigation method to use.

- Capital availability.
- Topography.
- Water availability.
- Types of soil.
- Type of crop to be irrigated.

❖ **Surface irrigation.**

Water is brought to crop fields from its source through canals or furrows.

Include: flood, furrow and basin irrigation.

Factors to consider in choosing surface irrigation.

i. Topography.

The land must be fairly level.

ii. Amount of water.

There must be a lot of water available for this type of irrigation.

iii. Soil type.

Soil must be able to hold a lot of water and allow it to stand for long period as it seeps into the soil by the roots.

i. Flood irrigation.

Water is allowed to flow into the field from a source such as a river through furrows or canals.

They are fitted with sluice gates to control the flow of water. The land to be irrigated must be level and there must be plenty of water.

It is relatively cheap to establish and maintain.

However there is uneven distribution of water to crops and plenty of water is wasted.

ii. Furrow irrigation.

Water flows from irrigation canals into furrows. Furrows should be dug along the contours to reduce soil erosion. Crops are planted on the ridges of the furrows.

Furrows should be maintained by repairing when eroded or worn out, removing weeds and accumulated silt.

- It reduce fungal diseases such as blight as it does not wet the leaves.
- It is cheap to establish and requires little skills.

However the limitations are:

- A lot of water is lost through evaporation and ground seepage.
- Soil erosion may occur where furrows are not properly planned or maintained.

iii. Basin irrigation.

- Involves flooding the whole are enclosed by earth embarkments called dykes or levees.
- The depth of water is controlled by the dykes or levees. Soil should be made level and dykes constructed around the leveled ground.

- The levelled ground surrounded by dykes is called the level basin.
- Soils should be able to hold water for a long time with little infiltration. Requires soil such as clayey. Common in rice fields which are flooded throughout the growing period.
- For land that is not level, it becomes very expensive to construct level basins.
- It may results in accumulation of a lot of salts I n the soil.
- Maintenance involves rebuilding the levees if broken and removal of weeds from canals, basin inlets and outlets.

- **Sub-surface irrigation.**

Involves laying perforated pipes underground to allow water to pass through tiny holes and wet the soil around the root zones of the crop.

Requires soils of high capillarity and water holding capacity.

Advantages of sub-surface irrigation.

i. Minimizes labour requirements, especially in changing water pipes.
ii. No need of constructing dykes, levelling or making level basins.
iii. It can be practiced on both sloppy and flat land.
iv. Water does not cause erosion because it comes out in small amounts.
v. Fungal diseases such as blight are reduced, because water does not accumulate on leaves.
vi. Economises on the use of water.
vii. Minimizes possible theft of pipes.

Disadvantages.

i. It is an expensive undertaking for example in buying pipes and laying them especially in large areas.
ii. Pipes can be broken during weeding or land preparation.
iii. Nozzles can be blocked and this makes irrigation inefficient.

- **Drip or trickle irrigation.**

Plastic pipes with tiny perforations are mainly used. They are laid on the ground wetting the soil around the base of the crop.

Advantages of drip irrigation.

i. Little amount of water is required as compared to other types of irrigation.
ii. Water under low pressure can be used as long as it can flow along the pipe.
iii. It discourages fungal diseases such as blight, CBD and others, as it does not wet the leaves of the crop.
iv. It does not encourage the growth of weeds between the rows.

Disadvantages.

i. The pipes are expensive to buy and thus it is practiced on limited scale.
ii. Requires clean water only as dirty water blocks the perforations.

- **Overhead irrigation.**

Application of water above the crops by means of sprinklers or watering cans. Water must be under high pressure. Wind may misdirect the water and thus a windbreak may be established.

Maintenance.

- Lubricating the rotating parts.
- Repairing broken parts.
- Cleaning to unblock nozzles.

Advantages of overhead irrigation.

i. Water is evenly distributed over the required area.
ii. Water is evenly distributed over the required area.

iii. There is less water distributed over the required area. It can be practiced even in sloppy areas.
iv. Foliar fertilizers can be applied together with irrigation water thus reducing the labor costs.
v. Sprinkler systems can easily be moved from one place to another.

Disadvantages.

i. Expensive installations are required e.g. buying pipes sprinklers and a water pump.
ii. Encourages fungal diseases such as blight due to water accumulating on leaves.
iii. Causes soil erosion if it is not properly controlled especially in sloppy ground.
iv. It may require the establishment of windbreak.
v. Maintenance of the system requires a lot of skill and it is also expensive.

DRAINAGE.

It is a method of removing excess water or lowering the water table from marshy waterlogged land. It is a method of land reclamation.

Importance of drainage as a land reclamation method.

- **It increases soil aeration:** excess water around the root zone retards plant growth because it fills the air spaces restricting air movement.
- **To increases soil volume:** amount of soil around the root zone from which roots can easily get nutrients easily is increased.
- **To raise soil temperature:** improves the rate at which soil warms up for better plant growth.
- **To increase microbial activities:** micro-organisms in the soil increase in number due to proper aeration. Help to improve soil structure and make plant food more readily available.
- **To reduce soil erosion**: well drained soils have high water holding capacity which helps to reduce run-off and increase infiltration rate.
- **To remove toxic substances:** due to waterlogging, soluble salts increases in concentration to levels that are toxic to plants. Drainage removes such salts from the soil.

Methods of drainage.

- **Open ditches.**

  Ditches are dug for water to flow in by gravity thus lowering water table. Ditches may be U-shaped, V-shaped or trapezoidal.

- **Underground drain pipes**.

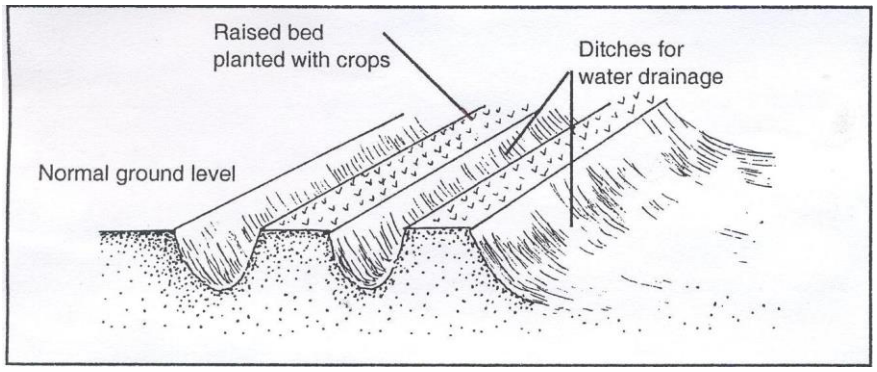
Perforated pipes are laid underground where water seeps from the surrounding area into the pipes. Such drains do not interfere with field operations. Drain pipes could be made of steel, clay or plastic materials.

- **French drains**.

Ditches are dug, filled with stones and gravel and then covered with soil. Water from the surrounding area seeps into these drains and is carried into a waterway.

- **Cambered beds**.

Raised beds are constructed and are use with combination with ditches. Used on poorly drained soils such as black cotton soil.



- **Pumping.**

In low lying areas where other methods are not suitable water is pumped out of the soil.

- **Planting trees.**

Trees such as eucalyptus that consume a lot of water are used to drain excess water from soils.

WATER POLLUTION.

Any process which leads to harmful increase in the amount of chemical substance or forms of energy released into the environment by human activities.

Agricultural practices that pollute water.

i. **Use of inorganic fertilizers.**

These get leached through the soil, they are carried into water bodies thus polluting the water.

ii. **Use of pesticides.**

Excess pesticides used in agricultural production seep into the soil and finally join the water bodies causing pollution.

iii. **Poor cultivation practices.**

Include.

- **Over cultivation.** This encourage soil erosion which eventually causes siltation in water sources.
- **Overgrazing.** Leads to soil erosion which causes siltation thus pollution.
- **Cultivation along river banks.** This encourages soil erosion and subsequent pollution of the rivers.

Methods of preventing water pollution.

i. Soil conservation measures should be taken to minimize soil losses through erosion. Terraces should be constructed in steep areas.
ii. Fencing of water sources to minimize possible pollution by livestock or humans.
iii. There is a need to enforce by laws the use of integrated methods of controlling pests and weeds as opposed to using chemicals.
iv. River banks should be vegetated by planting grass to minimize siltation in rivers.
v. Employing adequate storm water control methods and disposal systems especially in areas with heavy rains.

CHAPTER SIX.

SOIL FERTILITY: ORGANIC MANURES.

Soil fertility.

The ability of the soil to provide crops with the required nutrients in proper proportions and form for high production.

Characteristics of fertile soils.

i. **Good depth.**

Deep soils give plant roots greater volume to obtain plant nutrients and provide strong anchorage.

ii. **Proper drainage.**

A well-drained soil is properly aerated promoting healthy root development. They allow root respiration and reduce the buildup of carbon (iv) oxide to toxic levels.

iii. **Good water holding capacity.**

This ensures that enough water is retained for plant use.

iv. **Adequate nutrient supply.**

Should supply the nutrients needed by plants in the correct amounts and in a form that is available to the crops.

v. **Correct soil pH.**

Different crops have different soil pH requirements. Certain plant minerals are only available at a specific soil pH.

vi. **Free from excessive infestation of soil borne pests and diseases.**

HOW SOIL LOSES FERTILITY.

i. **Leaching.**

As water infiltrate into the soil it dissolves soluble minerals. The dissolved minerals are carried to lower horizons beyond the reach of many plant roots. A soil with many nutrients that have been leached is infertile.

ii. **Soil erosion.**

It is the carrying away of the top fertile soil. Leads to loss of good soil and plant nutrients rendering soil infertile.

iii. **Monocropping.**

- It is growing one type of crop on a piece of land over a long time (monoculture). The crop uses only those nutrients it require while other nutrients remain unused.
- This leads to exhaustion of some particular nutrients.

- The crop grown utilizes nutrients from a certain zone thus soil in that zone become infertile as far as that crop is concerned.
- There is build-up of pests and diseases if one crop is grown continuously.

iv. Continuous cropping.

Harvested crops remove large amounts of nutrients from the soil.
The nutrients removed from the soil are taken away making soil deficient in these plant nutrients.

v. Change in soil pH.

Changes in soil pH affects the activity of soil micro-organisms as well as the availability of soil nutrients.

vi. Burning of vegetation cover.

- When vegetation is burnt, organic matter is destroyed leading to the destruction of soil structure.
- Accumulation of ash formed after burning cause nutrient imbalance which may lead to unavailability of some nutrients.
- Micro-organisms are also destroyed thereby interfering with microbial activities such as nitrogen fixation and decomposition or organic matter.
- The soil is also left exposed to the agents of soil erosion.

vii. Accumulation of salts.

- Soil water contains dissolved mineral salts which comes from parent rock. Other salts comes from decomposition of organic matter.
- Where rainfall is irregular and insufficient to remove salts from the soil, coupled with high evaporation rates and poor natural drainage, results in salt accumulation or **salinization** on the soil surface.
- Soils with a lot of salts are saline and the state of having too much salts in the soil is referred to as **soil salinity.**
- The salts causes water deficiency and may lead to change of soil pH.

MAINTENANCE OF SOIL FERTILITY.

i. Control of soil erosion.

The measures to control soil erosion aims at promoting good water infiltration and reducing runoff. Includes: terracing, contour cultivation, strip cropping, cut-off drains and planting cover crops.

ii. Crop rotation.

Practice of growing crops of different families on the same piece of land in an orderly sequence.
Helps to control crop pests, diseases and weeds.
Ensures maximum utilization of soil nutrients by growing a variety of crops which have different nutrient requirements.
Legumes in a rotation programme improves the soil nitrogen.

iii. Control of soil pH.

Most living organisms do well at a pH around neutral.
Extreme pH inhibit the activities of living organisms.

iv. Proper drainage.

Can be done by breaking hard layers impeding drainage. Where poor drainage is as a result of poor soil structure and texture, water channels can be used.

v. Weed control.

The weeds compete with crops for growth resources such as: nutrients, soil moisture, space and sunlight.
Some weeds acts as alternate hosts of crop pests and diseases.

vi. Intercropping and mixed cropping.

Intercropping offers a better ground cover thus smothering weeds and controlling soil erosion.
Legumes intercropped with cereals fix nitrogen which is used by the cereal crops.

vii. Minimum tillage.

Over cultivation destroys the soil structure leading to soil erosion. Therefore unnecessary land operations should be avoided.

viii. Use of manure.

Supply organic matter, which on decomposition releases nutrients into the soil. This increases the water holding capacity, moderates soil pH and improves soil structure which helps to control soil erosion.

ix. Use of organic fertilizer.

Chemical substances which are manufactured to supply specific plant nutrients. Once used they improves the soil fertility.

ORGANIC MATTER.

Manure are organic substance that are added to the soil to provide one or more plant nutrients. Organic manure supplies organic matter to the soil which after decomposition releases plant nutrients.
Humus. The end product of decomposition. Humus forms part of soil colloids which improves soil chemical properties.

Importance of organic matter in the soil.

i. It increases the water holding capacity of the soil, it also increases the infiltration rate due to its colloidal nature.
ii. It improves soil fertility by releasing a wide range of nutrients into the soil.
iii. Provides food and shelter for soil micro-organisms responsible for the decomposition of organic matter.
iv. Improves soil structure. Humus binds soil particles together thus improving the soil structure. Drainage and aeration are also improved.
v. It buffers soil pH. That is, it moderates soil pH by avoiding rapid chemical changes.
vi. Reduces the toxicity of plant poisons that may have built up in the soil as a result of continuous use of pesticides and fungicides.
vii. Humus which is mostly dark in colour gives the soil its dark colour. Black colour absorbs heat, thus helps to moderate soil temperatures.

The use of manures, however is limited to small scale due to:

i. **Bulkiness.** Have low nutritive value per unit volume thus required in large quantities.

ii. **They are laborious in application and transport.** Thus increases cost of production.

iii. **They may spread pests, diseases and weeds.** If the materials used to prepare manure is infested.

There is loss of nutrients. If they are poorly stored. Soluble nutrients are easily leached and some are volatilized when exposed to hot sun.

i. **They may scorch the crops if used when not fully decomposed.** The crop does not benefit from them because it releases nutrients which can scorch the crop.

Types of organic manure.

Manure is classified according to method of preparation and the materials from which it is made.

1) **Green manure.**

Made of green plants. The plants are grown for the purpose of incorporating into the soil. Leguminous plants are preferred because they fix nitrogen.

Characteristics of plants used as green manure.

i. They should be highly vegetative or leafy.
ii. They should have a fast growth rate.
iii. They should have a high nitrogen content, thus leguminous plants are preferred.
iv. The plants must be capable of rotting quickly.
v. The plants should be hardy, that is, they should be capable of growing in poor conditions.

Reasons why green manure is not commonly used.

i. Most of the crops grown are food crops and it is hard for people to use them as green manure.
ii. Green manure crops might use most of the soil moisture and leave very little for the next crop.
iii. Most of the nutrients are used up by micro-organisms in the process of decomposing the green manure plant. These are released only when the micro-organisms die.
iv. It takes time for green manure crop to decompose and therefore planting is delayed.

2) **Farmyard manure. (FYM)**

It is a mixture of animals waste (urine and dung) and crop residues used as animal beddings.

Factors determining the quality of farmyard manure.

i. **The type of animal used**. Dung from fattening animals has higher level of nutrients than from that of dairy animals.Non-ruminats absorb less nutrients from their feeds hence their dung has a higher level of nutrients.
ii. **Type of food eaten**: feedstuffs that are highly nutritious results in manure with a higher level of nutrients.
iii. **Type of litter used**: wood shavings and sawdust are slow to decompose and contain very little nutrients. Napier grass provides both nitrogen and phosphorus but has low urine absorption capacity. Litter used with a high urine absorption capacity.
iv. **Method of storage**: FYM must be stored well in a leak proof and concrete floor to prevent loss of nutrients though leaching and vaporization.
v. **Age of FYM**: well rotten manure is rich in nutrients and it is easy to handle and mix with the soil.

3) Compost manure.

Manure prepared from composted (heaped) organic materials. The compost materials include plant residues and animals waste or plant materials only.
Avoid materials such as synthetic and plant with pests, diseases and weed seeds.

Factors to consider when siting a compost manure site.

i. **A well-drained place.**

This avoids waterlogging which leaches nutrients from the manure.

ii. Direction of prevailing wind.

Should avoid direct drift from the compost manure to the dwelling place. This prevent bad odour being blown to the homestead.

iii. Size of the farm.

The site should be centrally placed to the area of the farm where it is to be used.

iv. Accessibility.

The site must be easily accessible to make it easy for transportation of materials needed.

Preparation of compost manure.

There are two methods of preparing compost manure.

1) Indore method (pit method.

Devised at a place called Indore in India. Materials are packed into a pit 1.2M long, 1.2M wide and 1.2M deep.
Materials are put in layers.

- **Layer one.**

Fibrous materials such as maize stalks which forms the foundation of the compost layers.

- **Layer two.**

Layer of grass, leaves or any type of refuse material.

- **Layer three.**

Well rotten manure. This provide nutrients to micro-organisms.

- **Layer four.**

Thin layer of wood ash. This improves the level of potassium and phosphorus in the resulting manure.

- **Layer five.**

A layer of topsoil. It introduces micro-organisms necessary for decomposition of the organic, materials.

- The above sequence is repeated until the pit is full.
- During the dry season materials should be kept moist by adding water.
- The materials used should be young. However, if old materials are used, nitrogenous fertilizers should be added to raise the level of nitrogen in the manure.

- Materials should not be compacted to increase air supply for fermentation.
- The pit should be covered to prevent entry of too much water causing waterlogging.

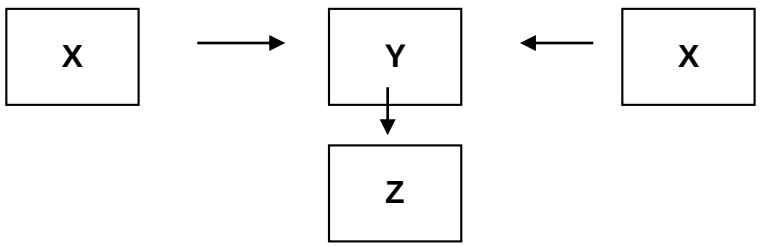
- Five pits are dug in a series and materials filled as follows:
- Pit 1, 2, 3 and 4 are filled with fresh materials. After 3 to 4 weeks, materials in pit 4 are transferred to pit 5, materials in pit 3 to 4, in pit 2 to 3 and in pit 1 to 2. The process is repeated until the materials that was first prepared first is well rotten and taken to the filed.

2) Four heap system. (Stack method)

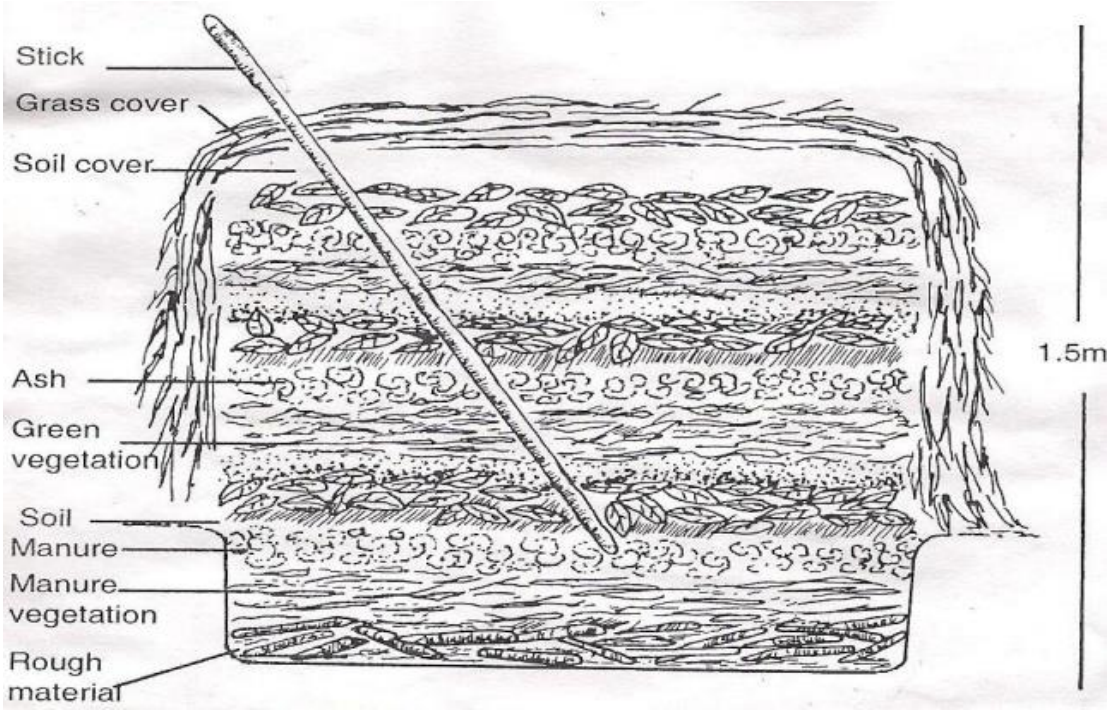
Four heaps are used. The materials on each heap are crop residue, animal waste, old farmyard manure, inorganic fertilisers and top soil

Construction.

Surface vegetation is cleared and topsoil scraped off the site and the ground is levelled.
Posts are fixed at a distance of 1.2M apart to form corners of the heap. Posts should be 2M high.
Wood planks are fixed on the sides and materials arranged



- If four heaps are used, materials are placed in the heaps labelled X. after 3 to 4 weeks, the decomposing materials are transferred to heap Y. after another 3 to 4 weeks the compost materials are transferred to heap Z where it stays for another 3 to four weeks then it is taken to the field.



A long sharp pointed stick is driven into the pile at an angle.

The stick is used for checking temperatures within the heap. If too high water should be added.

CHAPTER SEVEN.

LIVESTOCK PRODUCTION: COMMON BREEDS.

Livestock.

All those animals reared on the farm to directly benefit man. Includes; cattle, sheep, goats, pigs, poultry, rabbits, camel, fish, camel and bees.

IMPORTANCE OF LIVESTOCK.

a) **Source of food.**

Some animal's products are utilised as food. These include; meat, milk, eggs, honey and blood.

b) **Source of income.**

The various products are utilised at home and the surplus sold. The animals themselves can also be sold to earn income.

c) **Cultural uses.**

Includes.

- **Status symbol.**

One is regarded to be wealthy on owning large herds of cattle, sheep or goats. Thus one becomes highly placed in the society.

- **Medium of exchange.**

In olden days barter trade was the only of form of trade. Animals were thus used as medium of exchange.

- **Social ceremonies.**

Some traditional ceremonies like marriage and funerals require the offering of live or slaughtered offering.

- **Recreational purpose.**

These include activities like cock fighting, bull fighting, ostrich, camel, donkey and horse races.

d) **Animal power.**

Camels, donkeys and oxen are used to provide draught power which is needed in pulling of carts and ploughs.

e) Provision of raw materials.

- Animals are sources or raw materials for textile industry, theses raw materials include; wool, fur, mohair, hides and skins.
- The waste products such as dung are used in maintaining soil fertility.
- Cattle dung is used in synthesis of biogas.

COMMON LIVESTOCK BREEDS.

Breed.

A group of animals having the same characteristics and a common origin.

Cattle breeds.

Terms used to describe animals of different age and sex.

- **Bull.** Mature male cattle.
- **Bullock.** Mature castrated male cattle.
- **Steer.** Young castrated male cattle.
- **Cow.** Mature female cattle.
- **Heifer.** Young female cattle between weaning and first calving.
- **Calf.** Young one of cattle.

There are two categories of cattle breeds based on place of origin.

- Indigenous.
- Exotic cattle breeds.

Indigenous cattle.

- Native or local cattle that have their origin within the tropics.
- Belong to a class called **Bos indicus.**
- They are not classified as breeds because of their variation in characteristics due to a lot of uncontrolled breeding over the years.
- Includes; the small East African Zebu which comprises of Maasai, Nandi, Ankole, Bukendi and Karamajong. Mainly kept for meat with little milk production.

General characteristics of indigenous cattle.

i. They have humps which stores fat, which is broken down to energy and water in times of starvation.
ii. They are fairly tolerant to high temperatures due to the presence of dewlap and thick hides.
iii. They have high tolerance to tropical diseases such as trypanosomiasis.
iv. They have slow growth rate leading to late maturity. Heifers are served at the age of 2-3 years.
v. They have low production of both meat and milk due to inheritance of poor characteristics.
vi. They can walk for long distances in search of food and water.
vii. They can stay for long periods without food and water without seriously affecting their performance and body condition.
viii. They have a long calving interval of more than one year.

Exotic cattle breeds.

Originated from temperate regions of Europe.

They belong to a class of cattle called **Bos taurus.**

General characteristics of exotic cattle breeds.

i. They have no humps.
ii. They have low tolerance to high temperatures and this makes them popular in cool climate of the Kenya highlands.
iii. They are highly susceptible to tropical diseases.
iv. They have a fast growth rate leading to early maturity. Heifers are served at 1 ½ -2 years.
v. They are good producers of both meat and milk.
vi. They have short calving intervals of one calf per year if well managed.
vii. They cannot walk for long distances.

They are further divided into groups namely:

- Dairy cattle breeds.
- Beef cattle breeds.
- Dual purpose breeds.

1) Dairy cattle breeds.

General characteristics.

i. Their bodies are wedge to triangular shaped. This is due to heavy hindquarters with a tapering shape towards the head.
ii. They have a straight top line.
iii. They have a well set apart hindquarters to allow room for the big udder.
iv. They have large and well-spaced udders with large teats that are well spaced.
v. They have prominent milk veins.
vi. Their lean bodies carry little flesh. This is easily noted if the pin bone is visible.
vii. They have a large stomach capacity that enables the animal to feed heavily for high milk production.
viii. They are docile with mild temperament.

A. Friesian.

Origin.	Holland. It is also known as Holstein.
Colour.	Black and white. It may appear white with a few black marks or black with a few white marks. However, the tail switch, the leg parts below the knees and a patch on the forehead are always white.
Size.	Largest dairy breed. Cows weigh 550-680kgs and bulls 900-1000kg. Calves have a birth weight of 35-40kg.
Milk production.	Highest producing milk breed with an average of 9,150 kg per lactation of 305 days. Milk has low butter fat content of 3.5%. Heifers reach service age at 21 months. Friesians are good feeders and requires large quantity of fodder.

B. Ayrshire.

Origin.	Scotland.
Colour.	It is either dark brown or red with white marking or white with dark brown or red markings.
Size.	Bulls weigh 500-720 kg while cows weigh 360-590Kgs. Calves weigh 30-35kgs at birth.
Milk production.	Under good management, milk yield may reach 5,185Kgs per lactation period of 305 days. Butter fat content is 4%. Heifers are served at 21 months of age. They are hardy and are able to feed even in poor pastures.

C. Guernsey.

Origin. Guernsey Island off the coast of France in the English Channel. It is thus known as channel island breed.

Colour. Brown with white colour in the face, leg parts below the knees and hocks, tail switch and flanks. Colour ranges from fawn to almost brown.

Size. Cows 450-500Kgs and bulls 540-770Kgs. Calves weigh 25-30Kgs at birth.

Milk production. Produces an average of 6100Kgs per lactation period of 305 days. Milk has 4.5-5% butter fat content. Has moderate pasture requirements.

D. Jersey.

Origin. Jersey Island in the English Channel. It is known as Channel Island breed.

Colour. Varies from light yellowish brown (fawn) to a shade of black. Has protruding black eyes. The tail switch and muzzle are black. Has a small wedge shape with a dished face hence has true dairy conformation.

Size. The smallest dairy breeds. Cows weigh 350-450Kgs and bulls 540-700Kgs. Calves are born small, weigh about 20-25Kgs.

Milk production. Produce the lowest amount of milk but has a butterfat content of about 5-5.3%. Under good management, they produce 4,270Kgs of milk per lactation of 305 days. Has little pasture requirements and it is an excellent grazer in poor pastures.

2) Beef cattle breeds.

General characteristics.

i. They are blocky in shape that is appear rectangular with compact bodies.
ii. They have deep well fleshed bodies.
iii. They grow fast leading to early maturity.
iv. They are efficient converts of food into meat and fat.
v. They are able to maintain good weight even during adverse conditions such as drought.
vi. They are more tolerant to high temperatures.
vii. They breed regularly.
viii. They are good forages that is there is reduced selective grazing.
ix. They are more resistant to diseases.
x. They have short strong legs to support their heavy bodies.

A. Aberdeen Angus.

Origin. North East Scotland in the country of Aberdeen.

Colour. Black with long smooth coat of hair.

Size and conformation. Large breed appearing cylindrical, compact, lowly set, broad and deep, smooth and well-muscled throughout the body. It matures early. Carcases is of high quality with high dressing percentage. Cows weigh 720Kgs and bulls 900Kgs. Cows have good mothering ability. It is polled.

B. Galloway.

Origin. Scotland.

Colour. Black in colour and often has a brown tinge on the coat.

Size and conformation. Similar to that of Aberdeen Angus but with a rather longer body and hindquarters not well developed. The woollen appearance together with a thick hide enables the animal to withstand cold conditions.

C. Hereford.

Origin. England in the country of Hereford.

Colour. Deep red body with the face and leg parts below knees and hocks always white. The white colour can also be found on the tail switch, flanks, underline and brisket.

Size and conformation. Rectangular in form with deep and thick flesh. Has large hindquarters. Cows weigh about 840Kgs and bulls 1000Kgs.

D. Beef shorthorns.

Origin. England.

Colour. Red, roan or white. It is slow in growth and late maturing. It can produce a good amount of milk.

Size and conformation. Cows weigh 545-630Kgs and bulls 700-900Kgs.

3) Dual purpose cattle breeds.

- Breeds of cattle that are good in production of both meat and milk.
- However these breeds do not excel in production of either product.

A. Sahiwal.

Origin. Pakistan.

Colour. Brownish-red.

Size and conformation. They are heavily built and short -legged. Has high temperature tolerance. Udders are large. Milk production 2700-3000Kgs per lactation with 3.7% butterfat. Have large dewlaps and fluffy umbilical fold. They do not let down their milk easily. They are used to cross breed local cattle for milk production.

B. Red Poll.

Origin. England.

Colour. Deep red in colour with a white nose.

Size and conformation. Medium-sized breed with cows weighing 450Kgs. It is polled and the back is broad and straight. Has deep ribs and medium to short legs.

C. Simmental.

Origin. Switzerland.

Colour. Has a light red white and a white head.

Size and conformation. It is a very large and heavy breed that has a fast growth rate and average milk production. It can produce 3600Kgs of milk per lactation with butter fat content of 4% under good conditions of supplementary feeding with high quality fodder.

PIG BREEDS.

Terms used to describe pigs of different age and sex.

- **Piglet.** A young pig from birth to weaning.
- **Gilt.** Young female pig from weaning up to first parturition.
- **Sow.** a mature female pig after first parturition.
- **Boar.** A mature male pig.

1. **Large white.**

- Originated from Britain. It is long, large and white pig.

- The skin may have a few blue spots. Snout is broad and slightly dished. Ears are upright.
- Most prolific pig breed. Sows have good amount of milk for the piglet. Slow maturing but a good
- Converter of feed into meat. Mature sow weigh 300Kgs and boars 350Kgs. Kept for pork Production.

2. **Landrace.**

Originated from Denmark. White in colour. It has a straight snout and long ears drooping over the Face. It is a long lean pig. The hams are deep and broad. It has weak legs but is prolific with good Mothering ability. It is kept for bacon production.

3. **Saddlebacks.**

They have a black body with a white stripe over the shoulders. Both breeds have long heads and Snouts that are slightly dished. The ears are slightly drooped. Kept for pork production.

Can utilise soft young grass. Have good mothering ability and are quiet.

i. **Essex saddleback.**

Has a black body with shoulders and all four legs white.

ii. **Wessex saddlebacks.**

Has a black body with the shoulders and only the front legs white.

4. **Berkshire.**

Black with white colour on the feet, nose and tail. Kept for bacon production.

5. **Middle white.**

Originated from Britain. It is white. Similar to large white except for the small size. Ears are erect and the snout slightly dished. Prolific and has a good mothering ability. It is early maturing.

Kept for bacon production.

6. **Duroc jersey pig.**

Developed in Britain. It is pure black. It has a long body with dropping ears. It is a hardy breed.

Kept for both pork and bacon production.

POULTRY BREEDS.

Poultry refers to domestic birds kept for meat or egg production. They include; chicken, ducks, pigeons, geese, ostriches and turkey.

Commercial chicken are kept for either meat (**table birds.)** or broilers or eggs (**layers).** Table birds are usually heavy and fast growing while layers are light bodied and produce large eggs of 50-60 grams each.

Terms used to describe poultry of different age and sex.

- **Chick.** Newly hatched bird from one day to eight weeks old.
- **Pullet.** Young female bird from eight weeks to point of lay.
- **Cockerel.** Young male bird from eight weeks up to maturity.
- **Hen.** Mature female bird.
- **Cock.** Mature male bird.
- **Layer.** Bird kept for egg production.
- **Broiler/table bird.** Bird kept for meat production.
- **Capon.** Bird which has been rendered sterile.

A crossbred which has acquired the characteristics of the parent breeds is said to have hybrid vigour or heterosis. The birds do not go broody.

They various pure breeds are divided into either heavy or light breeds.

Heavy breeds.

- Rhode Island.
- Light Sussex.
- New Hampshire.
- Red and black Australops.

Light breeds.

- Leghorns.
- Ancona.
- Minorca.
- Sykes.

Light Sussex.

British bred whose plumage is white in colour. The neck hackles, ends of wings and the tail have a few black feathers. Can be used as a dual purpose breed but lays smaller eggs than most good layers. Cocks weigh 4Kg and hens 3Kgs.

New Hampshire.

Originated from America. Has light red plumage. Matures very fast thus ideal as a table bird. Cocks weigh 4.5Kgs and hens 3.5Kgs.

Black Australops.

Originated from Australia and brought to Kenya by European settlers from South Africa. Has black plumage with a greenish sheen that looks beautiful in the sun. Hens lay fewer eggs as they often go broody and fatten quickly. Cocks weigh 4Kgs and hens 3Kgs.

SHEEP BREEDS.

Terms used to describe sheep of different age and sex.

Ram. Mature male sheep.

Ewe. Mature female sheep.

Lamb. A young one of any sex.

Sheep breeds are kept for either meat or wool production or both.

Wool Breeds.

The only sheep breed that has high quality wool is the Merino. Its wool is used to standardise wool from other breeds.

It originated from Spain. Popular for upgrading the local Red Maasai.

Characteristics of merino sheep.

- They have a small body and angular in form.

- They have a drooping rump.
- They are narrow in the chest and consequently have a close-together front.
- Their muzzle is flesh coloured.
- They are slow maturing and have a lambing percentage of 100.
- They are hardy breeds that does well under extensive conditions.
- They have a good flocking instinct which makes them to be put as a big flock under one shepherd.
- They produce fleece that is highly valued, long stapled (with a staple length of 8-10 cm) and is low in shrinkage.
- Under shorn conditions, the ram weighs 63-80Kgs and the Ewes 49-57Kgs. Carcass is of very low quality.

Meat Breeds.

They produce high quality mutton. They are covered with either low quality wool or hair.

1. **Dorper.**

Produces high quality carcass. Developed through crossing Dorset Horn and Black Head Persian. Thus it is regarded as an indigenous breed. White in colour with a black head. Suitable for hot and dry conditions. It is highly prolific with a god growth rate.

2. **Blackhead Persian.**

Has hair covering its body. Indigenous sheep that originated in Arabia. It is tolerant to harsh conditions.

Has a black head and other parts are white. It is long legged, has a fat tail and is polled.

3. **Red Maasai sheep.**

Indigenous breed which has ability to utilise poor pastures. Colour varies from white to red with hair covering the body.

Dual purpose breeds.

Breeds that are good in production of both mutton and wool.

1. **Romney marsh.**

Suited to high altitude areas that have permanently wet pastures. It is resistant to foot rot and worm infestation.

Characteristics.

- Wide head and poll that is well covered with wool.
- Wide chest with a straight back and short legs.
- Produces wool of medium length that weighs 3.6-4.1Kgs.
- Rams weigh 102-113Kgs.
- Black hooves.

2. **Corriedale.**

Has relatively high quality wool and meat. It is polled and well covered with coarse wool. Has moderately long legs well covered with wool to the hooves. Produces wool of good length and low shrinkage. Fleece weighs 5-5,5Kgs. Rams weigh 84.2-90.6Kgs. It is a crossbreed of Merino and Lincoln thus an exotic breed.

3. **Hampshire Down.**

It is hardy, large breed which thrives on poor pastures. It is prolific and early maturing.

General characteristics.

- Face and ears are dark brown or nearly black. It is well covered over the poll and forehead with wool.
- The rams weigh 125Kgs and Ewe 102Kgs.
- Fleece weight averages 3.6Kgs but is often downgraded because of black fibres. Wool is coarse and is about 7.5 cm long.
- Lambing percentage is 125-140.

GOAT BREEDS.

Reasons why goat are more popular in Kenya.

- They have low feed requirements compared to cattle and sheep.
- They are highly prolific. Some have twining ability. This coupled with their short kidding interval means that they take a short period to multiply stock.
- They are browsers which feed on twigs and shrubs hence can thrive in arid areas without being in competition with grazers such as cattle.
- They are well adapted areas with high temperatures making them ideal in dry areas.

Terms used to describe Goats of different age and sex.

Billy or Buck. Mature male goat.

Nanny or Doe. Mature female goat.

Kid. Young one of goat of any sex.

Dairy Goats.

They are further subdivided into temperate or exotic and tropical or indigenous dairy goats.

Temperate/exotic dairy goats.

Saanen.

Large white coloured goat. Originated from Switzerland. Has upright ears that point forward. Average milk yields is 3-3.5Kgs per day with a butterfat percentage of 3.5-4%

Toggenburg.

Originated from Switzerland. Brown in colour with two white stripes running from the eyes to the nose. It has ability to forage on local grass and shrubs. Milk yields average 2.5-3Kgs per day with 3.3% butterfat content.

British Alpine.

Originated from Britain.

Tropical/indigenous dairy Goats.

Anglo-Nubian.

Roan and white in colour. It has long legs, and flopping ears and is polled. Adult female weighs 60-70Kgs and produces 1-2 litres of milk per day.

Jamnapari.

Crossbreed between Indian Jamnapari and Egyptian Nubian. Originated from India. Colour ranges from fawn, white to black. Has large eyes that flop.it is horned. Produces 1-1.5 litres of milk per day. Adult female weighs 45-60kgs.

Meat goats.

Galla.

Has abilit7 to adapt to hot conditions. Has a white coloured body and has very good quality meat.

Boer.

Angora goat is reared for its hair called Mohair. Originated from Angora in Asia. Not very popular due to its vulnerability to internal parasites. It is white in colour.

RABBIT BREEDS.

Terms used in rabbits of different age and sex.

Kindling. Young one of a rabbit.

Doe. Mature female rabbit.

Buck. Mature male rabbit.

New Zealand White/Kenya White.

It is white and has red eyes. Most common breed and is kept for meat production. Weighs 4-5.5Kgs at maturity.

California White.

It is very prolific. White in colour with one or more of the following parts being black; ears, nose, paws and tail.

Flemish giant.

It is a grey or blue-black breed that has good meat.

Chinchilla.

Kept for meat. It also gives high quality fur.

Earlops.

It has drooping ears. It is white in colour.

CAMELS.

Adaptations of camel to arid and semi-arid areas.

Camels are kept for the following reasons.

Milk.

Produces about 9.0 litres per day in a lactation period of 300days with a butterfat content of 3-4%.

Meat.

It is more fibrous than beef or mutton.

Animal power.

They are beast of burden. They can carry loads of up to 300Kgs which are placed on the hump.

Species of Camels.

Camels are classified into two species depending on the number of humps.

Dromedary.

Has one hump. It originated from Arabia and Syria.

Bactrian.

Has two humps and is much smaller than Dromedary. Originated from Central America. Has more fur coverage on the body thus it is shorn and yields 5-12Kgs of fur per shearing season. Mainly found in temperate regions.

DONKEY.

Kept for the provision of animal power through direct carrying of loads, pulling of carts and ploughs.

CHAPTER EIGHT.

AGRICULTURAL ECONOMICS.

Economics.

Study of how man and society choose, with or without the use of money, to employ scarce productive resources to produce various commodities over time and distribute them for consumption now and in the future.

Agricultural Economics.

An applied science that aims at maximising output while minimising costs, by combining the limited resources to produce goods and services.

BASIC ECONOMIC CONCEPTS.

1) **Scarcity.**

Condition where the factors of production or resources necessary to satisfy production needs are limited in supply.

Production needs are unlimited thus a farmer is faced with the problem of limited resources to satisfy unlimited needs. Scarcity affects agricultural production in many ways for example a farmer may be unable to apply the recommended amount of inputs because of limited capital.

2) **Preference and choice.**

Preference is the selection of one thing or person over others.

Choice is the decision to select something.

Choice made is determined by such factors as the needs of the society, the farmer's preference and ecological factors.

3) **Opportunity cost.**

It is the value of the best forgone alternative.

Conditions under which opportunity cost is zero.

- When there is no alternative.
- When goods are offered for free.
- When resources are not limited.

FARM RECORDS.

Characteristics of good farm records.

Uses of farm records.

- Records help to compare the performance of different enterprises within a farm or other farms.
- They show the history of the farm.
- Guide a farmer in planning and budgeting of farm operations.
- Help to detect losses or theft on the farm.
- Help in the assessment of income tax to avoid over or under taxation.
- Helps to determine the value of the farm or to determine the assets and liabilities of the farm.
- Make it easy to share profits and losses in partnerships.
- Help in settling disputes among heirs to the estate when a farmer dies without leaving a will.
- Records help to show whether the farm business is making losses or profits. Helps the farm to obtain credit.
- Help in supporting insurance claims on death, theft and fire of farm assets.
- Provide labour information like terminal benefits like NSSF dues.
- They help the farmer in selling certain assets like farm animals, machinery.

Types of farm records.

A. Production records.

Show the total yield and the yield per unit of each enterprise.

The table below shows milk production records.

Name/No of cow	**DAYS IN THE MONTH**								CONTINUE TO END OF MONTH.	**TOTALS.**
	1		2		3		4			
	Am.	Pm.	Am.	Pm.	Am.	Pm.	Am.	Pm.		
Kairu.										
Gatune.										
Vitallis.										
Mbogo.										
Total.										

B. Inventory records.

There are two types of inventory records.

- Consumable inventory records.
- Permanent goods inventory records.

Consumable goods include; animal feeds, fertilisers, drugs and some construction materials like cement.

Permanent goods include; tools, equipments, machinery.

Example of consumable goods inventory.

RECEIPTS.			ISSUES.			
Date.	**Commodity/item**	**Quantity.**	**Date.**	**Issued to**	**Quantity.**	**Balance in stock**

Example of permanent goods inventory.

Date.	Commodity/item	Quantity.	Written off.	Balance in stock.	Comment.

C. Field operation records.

The farmer gives account of all that takes place in the field. For example the date of ploughing. Planting, fertilizer application. The records are kept per field or crop enterprises.

Season……	field No……
	Net area……..
Crop grown …….	Variety…….
Ploughing date…….	Planting date…….
Inputs:	
……	
Seed rate Kg/Ha……..	

Fertilizer at planting: type…… Amount…….

Top-dressing: fertilizer…… Amount……..

Other treatment……
……

Pests……. Control……

Diseases…… Control……..

Weeds…….. Control……

Other treatment

……..

Output.

Harvesting date……. Method used……

Yield/ha……
……..

Remarks……
……..

At the end of the season the farmer should work out cost of production for each field using inputs records.

D. Breeding records.

Records kept to show the breeding activities and programmes for different animals in a farm.

Breeding records card for cattle.

Dam.		Breed colour.	Parents: sire		Dam.

Dam No					
1st service	2nd service	3rd service	4th service.	Remark.	No of service.
Date of service.	Date of service.	Date of service.	Date of service.		
Time of service.	Time of service.	Time of service.	Time of service.		
Bull no Breed.	Bull no Breed.	Bull no Breed.	Bull no Breed.		
Pregnancy Diagnosis Date……..Results…….					
Expected date of calving.					
Actual date of calving.					
Weight of calf at birth.					
Sex of calf.					
No of calf					

Calving records.

Dam No	Sire No	Date of service.	Date of calving.	Weight of calf.	Calf number/name	Remarks.
Dam 1.						
Dam 2.						

Dam 3.						
Dam 4.						

In breeding of sheep and goats where individual animal records are difficult to keep the farmer can use a format for the whole flock which is illustrated below.

Sheep and goats breeding records.

No of Ewes/Does.	Service period (month)	Period of lambing/kidding. (month)	Lambing/kidding Percentage. %	No Weaned	Remarks.

The records format above is applicable where there is a definite breeding programme and

Mating is restricted to a specified period.

Pig breeding records.

The record above shows breeding of sows within a year. It may be entered twice on the record if

It farrows twice

Sow No……. Breed……	Sire No…… Breed……..	Date of service	Date of farrowing		Remarks.
			Expected.	Actual.	
Sow 1…….. ……					
Sow 2 ……... …….					

within the year.

Individual sow breeding records.

Pen No…….	Dam No……. Breed. ……. Age of Dam……	Sire No…… Breed…….. Age of sire……	Service Date……... Farrowing Date…….. Litter size……
Age of piglets.	Average weight.	Total weight.	Remark.
Week 1.			
Week 2.			
Week 3.			
Week 4.			
Week 5.			

The individual sow breeding records above gives the details of the sow and its litter up to the time of weaning. The records helps in selecting a breeding stock.

E. Feeding records.

Kept to show the types and amount of feeds used in the farm.

Daily feeding records in the month of…….. Enterprise…….. Type of feeds…….					
Date.	No of Animals.	Amount received. (Kg)	Amount used. (Kg)	Balance in stock. (Kg)	Remarks.

F. Health records.

Records kept to show the health conditions of the animals on the farm. The records are Important during selection and culling of animals on health grounds. They help in calculating Cost of treatment and shows course of action to be taken in maintenance of health.

Date.	Disease symptom.	Animal(s) affected.	Drugs used.	Cost of treatment given	Remarks.

G. Marketing records.

Records that shows the commodity, quantity or amount sold, date, rate per unit of the

Commodity, total value and where sold.

Commodity……..

Date.	Amount sold.	Price per unit (Kshs)	Total value. (Kshs)	Where sold.	Remarks.

H. Labour records.

They should show the type of labour, date of employment, date and rate of payment, skilled or unskilled labour.

There are two types of labour records.

- Muster roll.
- Labour utilisation analysis.

Muster roll.

It is a record of the available labour on the farm. It is used to check the number of days they worked and therefore determine how much they should earn. Shows the name of the worker, the pay-roll number, and days worked, rate of payment, amount of salary or wages and signature.

Name of the person.	Pay roll number.	Days.					Days worked.	Rate of pay. (Kshs)	Total pay. (Kshs)	Signature of the worker.
		1	2	3	4	5				
Mr Ben	O8						25	@100/=	2500/=	
Mr Zack.	09						25	@ 100/=	2500/=	

Labour utilisation analysis.

It shows how labour is utilised on the farm. Helps to determine labour allocation,

Labour requirements for the purpose of budgeting and when labour is in peak demand or

When to lay-off unproductive labour.

No of hours worked.	Livestock production.	Crop production.	Machinery maintenance.	Date of working.	Remarks.
Cost/hour.					
Total cost.					

End.