**AGRICULTURAL SCIENCE SS 2**

**first TERM**

**SCHEME OF WORK**

1. Soil Types and Properties

2 & 3 Farm Machinery

4 & 5 Surveying and Planning of Farm Stead

6 & 7 Irrigation and Drainage

8. Environmental factors affecting Agricultural Production

9 & 10 Plant Nutrients and Nutrient Cycles

**WEEK 1**

# FACTORS OF SOIL FORMATION – LESSON NOTES

Soil formation is greatly controlled by five major factors which are (i) Climate (ii)Parent materials (iii) topography (iv) biotic (living organism) (v) time

1. Climate: Elements of climate such as rainfall, temperature, wind and pressure are all very important in soil formation.
2. Temperature: The alternating heating and cooling of rocks result in the continual expansion and contraction which eventually result in cracks in the rocks and its consequent breakdown into small pieces to form the soil. Temperature affects the rate of chemical weathering of rocks
3. Rainfall: The action of running water from rainfall causes the gradual wearing away of rocks during erosion of form soil. Rainfall provides water for hydrolysis. Also, rain drops may break down some parent rocks to form soil.

Rainfall enhances vegetative growth of plants whose roots cause further breakdown of rocks, while the rain water transports rock particles after disintegration.

1. Wind: High-wind velocity in deserts carry with it other tiny rocks which collide with

one another or other rocks, resulting in the breaking of rocks into tiny pieces to form soil. Wind also removes weathered materials, thereby, exposing parent materials to further breakdown.

1. Pressure: High pressure on a hanging rock may cause such rock to fall down and break into tiny pieces, resulting in the formation of soil.

Parent material: Parent materials constitute the major materials from which soil is formed. They are igneous, sedimentary and metamorphic rocks. Parent materials determine the chemical composition of the soil that is formed. It also contains different minerals which account for differences in the fertility of the soil formed from each of the different types. Parent materials determine the physical characteristics of the soil. Hardness of parent material affects the rate of soil formation.

Topography: The shape of the ground in relation to the underlying rock of the earth’s surface is known as topography. Topography affects the rate of run-off and erosion. Steep slopes encourage erosion and retard soil-formation. Soil-formation is faster in the valley than on slopes. Steepness of the slope affects the rate of abrasion of rocks; hence, soil is formed.

Biotic Factors (Living Organisms): The activities of living organisms help to speed up the process of soil formation.

Termite, earthworm, rodent mix the mineral and organic matter together, and these results in the formation of the soil.

They also allow water and air into the soil which eventually react with rocks to cause their break down into soil.

The activities of man during tillage and other farm operations indirectly help to break rocks into tiny pieces to form soil.

The activities of micro-organisms which promote decomposition of organic materials aid soil-formation.

The roots of plants penetrate rocks and break them into tiny pieces to form soil

They influence the organic matter content of the soil

Organisms produce carbondioxide which forms carbonic acid with water and enhances the weathering of rocks.

Microbes also improve the soil aeration and water percolation. This enhances chemical and physical weathering.

Microbes help in the decomposition of organic matter in the soil.

The decay of fallen leaves of trees with the aid of bacteria results in the formation of humus, and this is rich in plants food.

Time: Time also plays an important role in soil-formation. It takes a long time for mature soil to be formed.

It takes a long time for small pieces of rock to disintegrate into grains of soil.

It also takes a long time for plants to decay and become part of the soil

It also takes time for rainfall to leach chlorides, sulphates and carbonates from the soil.

It takes a short time in the formation of immature soil.

Time also determines whether or not the soil is well-developed.

## PROCESS OF SOIL FORMATION

The process of soil formation is called weathering. Weathering is defined as the disintegration or breakdown of rocks into tiny pieces to form soil. In other words, weathering can also be defined as the breaking down of rock masses (rock minerals) into simpler forms through the agents of physical, chemical and biological processes.

The Processes of soil formation include:

Physical process (2) Chemical process (3) Biological process

1. Physical process: Agents of physical weathering are temperature, ice, wind, water and pressure.
2. Temperature: The alternating heating and cooling of the rocks produce pressure within the rocks and cause them to break down into pieces.
3. Wind: As a result of the grinding of rock surfaces by solid materials carried by wind, water and moving ice (glacier), rocks break down to form soil.
4. Ice: The conversion of water inside cracks in rocks into ice results in increase in volume. This increase in volumes results in more pressure being exerted on the rock walls which eventually break into smaller pieces.
5. Water: Running water carries some fragments of rocks along its course and these rub against the surface of rocks in the river bed, thus breaking off small pieces of rocks.
6. Chemical Process: Agents of Chemical weathering include solution, carbonation, hydration, hydrolysis and oxidation.
7. Solution: This occurs when water dissolves and soluble minerals present in the rock are carried from place to place while water flows.
8. Carbonation: Atmospheric carbon dioxide mixes with rain water to form weak carbonic acid. This acid dissolves rocks, resulting in their breakdown.
9. Hydration: This is the attachment of water with rock minerals. This results in chemical alteration of the minerals, e.g the conversion of iron II rocks to hydrated rocks. Hematite rock is also changed to liminite.
10. Hydrolysis: This is the reaction of water with rock minerals to produce a rock, entirely different from the original one. For example olivine rock is changed to serpentine.
11. Oxidation: This is the reaction of rocks with oxygen from the atmosphere. This reaction eventually weakens and breaks down the rock to form soil.

Biological Process: This involves the activities of plants and animals in the breaking down to rocks to form soil.

It is caused by the action of animals like earthworms, termites and other soil organisms.

Movements of these organisms cause small fragments of rocks to disintegrate.

Earthworms and termites burrow into the rocks and break off fragments of rocks. The roots of growing plants penetrate rocks through crevices, exerting pressures which split some rocks.

The activities of man during farm operations such as ploughing and harrowing also break down rocks into tiny pieces.

# COMPOSTION (COMPONENTS OF THE SOIL)

The soil is made up of five components which are (i) In-organic (mineral) matter (ii) Organic water (iii)soil water (iv) soil air (v)living organisms.

Mineral or inorganic matter, organic matter, water and air are collectively referred to as physical components of the soil while living organisms are refered to as biological components of the soil.

1. Mineral or Inorganic Matter: The mineral matter represents small rock fragments of the soil. It forms the bulk of about 45% of total volume of the soil. It consists of gravel, stones, sand, silt and clay

## Importance/Effects of Mineral Matter on Agriculture

1. It forms the solid part of the soil and provides support for plants.
2. Mineral matter is the main source of plant nutrients such as nitrogen, calcium, magnesium, iron, etc.
3. It represents the home or habitat of all soil living organisms.
4. It holds water and air for both plants and animals activities.
5. Mineral matter has moderating effects on soil temperature.
6. It also affects soil porosity.
7. Organic matter: The organic matter represents the remains of the decomposition of plants and animals. It is about 5% of the total volume of the soil. Leaves, roots of plants, the residue of crops, animal dung e.tc, when deposited on the soil, decay to form a dark colour on the upper part of the soil known as organic matter or humus.

## Importance /Effects of Organic Matter on Agriculture

1. It is very rich in plant nutrients.
2. It is the habitat of many soil micro-organisms
3. It prevents leaching in soil where it is present in adequate amount.
4. It also prevents soil erosion and evaporation of soil water.
5. It allows for good drainage and hold water in the soil for plant use.
6. It improves the structure of the soil by binding the particles of coarse-texture soil together.
7. It increase water-holding capacity of the soil
8. It moderates the soil temperature which stimulates good development and growth of roots.
9. It has buffering effect that moderates pH values.
10. It improves soil cation exchange capacity
11. It improves soil aeration. xii. It is responsible for the loose, friable condition of loamy soil.

Soil water: Soil water refers to the water in the soil which is usually obtained either from rain or irrigation. Water represents 25% of the total volume of the soil. It is usually found in the soil within the pore spaces. When water is too much in a soil (covering the soil surface), the soil is said to be waterlogged. A waterlogged soil can, however, be improved by drainage to make such soil more productive. On the other hand, a situation where there is lack of water in the soil for a very long time to the extent that plants cannot absorb water even when supplied again, results in a condition called permanent wilting point. The plant at this stage can die.

## Types of Soil Water

There are four major types of soil water. These are:

1. Hygroscopic water: This water is tightly held by the soil particles such that it is never available to the plant.
2. Field capacity: This is the type of water left in the soil after excess water has been drained off, following heavy rainfall. This water is available to the plants.
3. Capailary water: This is the water which rises above the water table in the soil and it is held in the fine and medium pores of soil particles by surface tension. Capillary water is easily available to plants.
4. Gravitational water: this is the water which can drain from the soil under the influence of gravity. It is available to plants but it is often pulled down beyond the reach of the roots.

**Importance/Effects of Soil water on Agriculture:**

1. Water is an important agent of weathering of rocks in the soil.
2. It helps to dissolve plant nutrients into solution form which can easily be absorbed by plant roots.
3. Water is an essential raw material for photosynthesis.
4. Hydrolysis of may food nutrients and enzymatic activities are promoted by the presence of water.
5. Loss of water from plant through a process called transpiration is helpful in the cooling of the plants.
6. Presence of water aids easy tillage of the soil and also helps to improve the soil structure.
7. It also promotes the activities of soil organisms. viii. It is needed for the germination of seeds. ix. It provides the medium for soil reaction.

x. It aids the turgidity of cells. xi. It protects plants from injurious effects of high temperature.

4. Soil air: This refers to the gasses present in the soil pores found between the soil particles. The amount of soil air varies, depending on the amount of soil water, the sizes of the pore spaces, the type of soil and the amount of living organisms in the soil.

The percentage of air is about 25% of the total volume of the soil. The ability of air to circulate freely in the soil is called aeration.

## Importance /Effects of Soil Air on Agriculture

1. Soil air, especially oxygen, is necessary for the growth and development of plants.
2. Oxygen in the soil promotes easy germination of seeds.
3. Soil organisms require oxygen for respiration
4. Excess of carbon dioxide in soil when combined with water can cause acidity and aid weathering of rocks.
5. Some plant-disease organisms such as fusarium which causes damping-off are favored by poor aeration. vi. It is needed in soil reactions, particularly carbon and nitrogen cycles.

Living Organisms: These refer to plant and animals which inhabit the soil. They range from microscopic organisms to bigger organisms. Some are beneficial while others are harmful to crops and livestock. The most commonly found groups of soil organisms include bacteria, fungi, virus, nematodes, insects (

e.g, termite, soldier ants), millipede, centipede, earthworm, snails, reptiles, mammals (e.g. rats and rodents)

## Importance/Effects of Living Organisms on Agriculture

Soil organisms are very useful in many ways, especially in soil-formation and improving the soil for the growth of crops. Their effects are:

1. Soil organisms improve soil structure and granulation
2. They also improve the aeration of the soil.
3. They help to decompose organic materials in the soil to form humus
4. They improve soil water percolation or drainage.
5. They also increase the collocidal properties of the soil
6. Some organisms like bacteria help to fix nutrients into the soil.
7. Some soil micro-organisms produce acidic materials which help to break down rocks.
8. Soil organisms enhance the cation exchange capacity of the soil. ix. Through burrowing, they leave holes for crop root penetration.

x. They increase the mineral or nutrient status of the soil. xi. They stabilize soil pH through the increase in soil organic matter and buffering.

## SOIL TYPES AND THEIR PROPERTIES

Definition of Soil: Soil is defined as the uppermost layer of the earth’s crust which provides support and nutrients for plant growth.

There are three main types of soil. These are sandy soil, clay soil, and loamy soil.

Sandy Soil: Soil is said to be sandy if the proportion of sand particles in a sample of the soil is very high. The particles are mainly quartz (SiOz) and having a size of 0.02mmm to

2.0mm in diameter.

## Properties of Sandy Soil

1. Sandy soil is coarse, grained and gritty
2. It is loose with large pore spaces
3. It absorbs and loses water easily.
4. It is not sticky, when wet. Hence, it cannot form a cast or ribbon.
5. It is well aerated with low water holding capacity.
6. Percolation in sandy soil is high but capillarity is low.
7. Sandy soil heats up easily during the day and cools down quickly during the night
8. It support leaching. Hence, it is low in plant nutrients.
9. It does not support water logging and erosion
10. Sandy soil is low in plant nutrient. Hence, it does not support crop cultivation. xi. Sandy soil has grey or brownish colour.

## Methods of Improving Sandy Soil

Sandy soil can be improved throughout the following agricultural practices:

1. Planting cover crop: Cover crops help to provide shade, prevent erosion and add more nutrients to the soil.
2. Application of compost manure: Compost manure helps to bind the sand particles together and also add humus (nutrients) to the soil.
3. Application of farm yard manure: this will also improve the structure of the soil as well as add nutrients to the soil.
4. Mulching the soil: Muching sandy soil prevents water loss through evaporation and nutrient loss by water erosion
5. Avoidance of bush burning: Bush burning promotes soil erosion, kills soil organism and removes organic matter which can contribute to the fertility of the soil.

# Economic importance of Sandy Soil

1. It is good for the cultivation of few crops such as cotton, groundnut, cassava, e.t.c
2. It is also useful in building construction, especially its combination with cement and water in block-moulding.

Clay soil

Definition: Soil is said to be clayey if the proportion of clay in a sample of the soil is very high. The relative size of clay particle is less than 0.002mm in diameter. It is a heavy type of soil because it is difficult to work on or cultivate.

Properties of Clay soil.

1. Clay particles are fine, powdery and smooth when dry.
2. The particles are sticky and mouldy when wet.
3. The particles are tightly bound together with little pore (air) spaces
4. The structure is granular and does not lose water easily.
5. It is poorly aerated with high water holding capacity. vi. Percolation in clay soil is low but capillarity is high. vii. It does not support leaching. Hence, it contains plant nutrients. viii. It is hard when dry and sticky when wet.
6. It can easily form a robbor or cast when moulded.
7. It supports water-logging and erosion
8. It has a grey or brownish colour

Note: Clay soil can be improved through (i) liming (ii) addition of organic manure.

Loamy Soil

Definition: Loamy soil is a mixture of sand and clay particles with high proportion of organic matter. Loamy soil is more fertile than either clay or sandy soil. If a type of soil is described as sandy loam, it means that the proportion of sand is high and if it is clay loam, it shows that the proportion of clay is high, while that of sand is low.

Properties of Loamy soil

i. Loamy soil is moist, loose with moderate sized pore spaces. ii. The structure breaks easily when wet and friable when dry.

iii. It has non-powdery and non-sticky texture. iv. It can easily be worked on or cultivated.

1. It contains lots of organic matter (humus).
2. It does not support erosion and water logging. vii. It is well aerated and it can hold water.

viii. It contains plant nutrients, hence, it is the best soil for the cultivation of crops, e.g, maize, rice, cowpea, cassava, yam, tomatoes, okra, millet, pepper. ix. It is dark-brown or black in colour

Importance/Effects of Organic Matter on Agriculture

1. It is very rich in plant nutrients.
2. It is the habitat of may soil micro-organisms. iii. It prevents leaching in soil where it is present in adequate amount.
3. It also prevents soil erosion and evaporation of soil water
4. It allows for good drainage and holds water in the soil for plant use.
5. It improves the structure of the soil by binding the particles of coarse-texture soil together.
6. It increases water-holding capacity of the soil
7. It moderates that soil temperature which stimulates good development and growth of roots.
8. It has buffering effect that moderates pH values.

Properties of the Soil

Properties of the soil include soil texture, soil structure, soil temperature, porosity, soil colour, water-holding/retaining capacity and soil pH.

The properties of the soil are grouped into two:

a. Physical properties of the Soil: these properties include soil texture, soil structure, soil temperature, porosity, soil colour and water holding/retaining capacity.

1. Chemical properties of the soil: These include the soil pH and cation exchange capacity.

SOIL PROFILE

Soil profile is defined as the vertical section of the soil, showing series of horizontal layers of different types of soil. These horizontal layers are called horizons.

A soil profile in an area of the humid tropics such as the forest zones may have about four fairly distinct horizons. The first thing that is noticed in a soil profile is soil colour. The horizons show different colours, e.g., the top soil may be dark, followed by brown below.

After the colour, the next feature which can be noticed is the texture or particle sizes which increase from the top to the bottom. These two characteristics enable the different horizons to be identified.

Horizons of Soil Profile

The four major horizons of soil profile are:

1. The A-Horizon, also called the top soil, represents the surface layer of the soil profile. This horizon contains more organic matter than other horizons. The A horizon, the top soil, is the most weathered and leached of all the soil horizons. Most food crops, especially shallow-rooted crops derive their nutrients from this top soil, e.g, vegetables, legumes. E.tc
2. B Horizon: The B-horizon, also called the sub-soil, is the next horizon immediately after the top soil. It is rich in minerals which are carried or leached down by percolating water. The B-horizon is suitable for the cultivation of deep-rooted crops like cocoa, rubber, orange, oil palm e.t.c.
3. C-Horizon: The C-horizon, also called parent materials, represents the type of material from which top-soil and sub-soil are derived. It is the parent materials which are small fragments of rocks that are unweathered and found at the bottom of the soil profile.
4. D-Horizon: The D-horizon is also called the bedrock. It represents the unweathered rock materials. This horizon is found at the bottom of the profile and they are usually of large soil particles.

Importance of Soil Profile

The suitability of a soil for agriculture is determined by looking at the soil profile. The importance of soil profile includes:

1. Level of Soil fertility: Soil profile determines the level of soil fertility. A thick top soil represents high level of soil fertility.
2. To know the type of crop to grow: it helps the farmers to know the type of crop to grow. For example, shallow-rooted crops like cowpea, groundnut, e.t.c are grown in the top soil, while deep-rooted crops are grown where the sub-soil is thick.
3. Penetration of roots: A loosely-packed sub-soil allows for easy penetration of roots of crops.
4. Level of drainage and aeration: A loosely packed sub-soil also allows for easy drainage and aeration.
5. Easy percolation: A loosely-packed sub-soiled also ensures easy percolation of water, thereby preventing the occurrence of erosion.

SOIL TEXTURE

Definition: Soil texture refers to the relative proportion (sizes) of the various particles of the soil. In other words, it refers to the degree of fineness or coarseness of the various soil particles.

The particles that make up a soil sample include gravel, sand, silt and clay. Silt and clay are usually referred to as the primary particles of the soil.

The name and sizes of the various soil particles are shown in the table below.

Name of Particles Range of particles in diameter (mm)

|  |  |
| --- | --- |
| Clay | Below 0.002mm |
| Silt | 0.002-0.02mm |
| Fine sand | 0.02-0.2mm |
| Coarse sand | 0.2mm |

Gravel Above 2.0mm

Determination of Soil Texture

Soil texture can be determined by various methods. These methods include:

1. By feeling : Take a little sample of soil and rub them between the fore-finger and the thumb. A sharp feel represents the presence of sand while a smooth or powdery feel represents the presence of clay.

2 By mechanical analysis through sieving: The various sizes/fractions in a sample of dried soil can be separated by putting the sample into a series of various measured mesh diameters and shaking vigorously. One starts with the sieve which has the smallest mesh diameter and progresses up the table to the sieve with the largest. The particles which can pass through a particular mesh belongs to the corresponding grade of soil.

1. By sedimentation: A sample of soil placed inside a glass jar and large volume of water is added and the mixture is vigorously shaken and allowed to settle. At the end, large particles like coarse sand and gravel settle at the bottom, while the organic materials float on top of water in the glass jar.
2. By moulding: Mix a sample of soil with little water and try to mould the mixture. If the mixture is sticky. It shows that clay is present but if it is not sticky and cannot form a ribbon or cast, it shows that sand is present.

Importance of Soil Texture

Soil texture is very important, especially to farmers in the following ways:

1. It is useful in the evaluation of soil ability to supply mineral nutrients.
2. It supports soil micro-organisms essential for plant growth.
3. It determines the type of crop to grow on the land. iv. It enables the farmer to know the type of soil in his farmland.
4. It determines the relative proportion of air and water in the soil.
5. It determines the movement of air and water. vii. It helps o determine tillage practice to be adopted by the farmer.

Soil structure

Soil structure refers to the way in which the different particles of the soil are packed or arranged. It also refers to the shape and arrangement of primary particles form compound particles.

Soil structure has a direct effect on crop yield. If the soil structure is good, air will circulate well while waterlogging, erosion and leaching will be reduced. The structure of the soil can be preserved in the following ways.

1. Planting cover crops
2. Mulching
3. Application of manure (green manure and lime). iv. Avoidance of over-grazing and erosion.

v. Avoidance of clean cleaning with machines.

Types of Soil Structure

The different types of soil structure are:

1 Single-grained Structure: in this structure, the primary particles exist in single form and are not cemented together. It is found in sandy soil.

1. Crumb Structure: There exist large gravels or stones embedded within the primary particles which are cemented together. It is found in the top soil
2. Plate-like Structure: The primary soil particles are arranged horizontally and flat, resembling plates or leaflets on top of each other it is common found in the sub-soil.
3. Spheroidal Structure: This is also referred to as granular structure. The particles are cemented together in a circular form with lots of air spaces. It is commonly found in top soil.
4. Prismatic Structures: This could be columnar or prismatic. They are just like spheroidal structure with air spaces. When the top ones are round, they are columnar, but when they are flat just like a prism, they are prismatic. It is found in sub-soil.
5. Block-like structures: The aggregates are like blocks whose edges are irregular and may be either sharp or rounded. It is commonly found in the sub-soil.

Importance of soil structure

1. It determines the level of fertility of the soil
2. A good soil structure supports aeration
3. It also prevents erosion and water togging. iv. A good soil structure promotes the activities of soil micro-organisms.

v. A good soil structure has a good water-retaining capacity. vi. It also supports the growth of crops.

Soil Temperature

Soil temperature refers to the temperature within the soil. In other words, it is the temperature usually different from the temperature of the air above the soil.

1. Soil temperature affects the formation of soil organic matter.
2. Soil temperature affects the decomposition of soil organic matter.
3. It determines seed germination and not development
4. It also affects the population of soil microbes.

Soil pH

The word of pH (pondus de Hydronium) is defined as a measure of the degree of acidity or alkalinity of the soil. It can also be described as a measure of the concentration of hydrogen (H+) in the soil. A higher hydrogenions (H+) concentration indicates soil acidity while a lower concentration of hydrogen ions (OH+) indicates soil alkalinity.

Causes of Soil Acidity

Soil acidity can be caused by any of the following:

1 Leaching: The washing down of plant nutrients below the soil beyond the reach of the plant roots leaving behind hydrogen ions.

1. Use of acid fertilizers: The use of acid fertilizers like ammonium sulphate and ammonium nitrate can easily cause acidity in the soil.
2. Presence of acid parent materials: The presence of acid parent materials results in the easy dissolution of the rocks, leaving behind minerals rich in hydrogen ions.
3. Nutrient uptake by plants: The absorption of soluble minerals by plants results in the accumulation of hydrogen ions which cause soil acidity.
4. Presence of sulphur in the soil: sulphur undergoes oxidation and dissolution to form weak acid in the soil.

Removal of Soil Acidity

Soil acidity can be removed by the application of liming materials which are rich in calcium.

Examples of liming materials include:

1. Limestone (calcium carbonate) – CaCo3
2. Slaked lime – Ca (OH)2
3. Quick lime – CaO.
4. Calcium bicarbonate – Ca(HCO3)2
5. Wood ash (calcium phosphoilicate – Ca4 (PO4)2 SiO4
6. Dolomite or Calcite – Ca (HCO3)2
7. Basic slag – Ca3 (OHSiO3)2
8. Gypsum – CaSo4 2H2O ix. Organic manure can also be applied to the soil to remove soil acidity.

Questions:

1. What is soil
2. State five Characteristics of sandy soil
3. What is soil structure
4. What is soil acidity
5. State five causes of soil acidity

**WEEK 2& 3**

**FARM MACHINERY AND IMPLEMENTS**

## FARM MACHINERY

Farm Machinery includes various types of machines and implements used in the farm. These include tractors, ploughs, harrows, cultivators, ridgers, planters, harvesters, shellers, dyers, sprayers, incubators. The most important implement or machine in the farm, which is used for operating many far implements is the tractor.

Example of farm machines include tractor, bulldozer, tree puller, shelter, dryer, incubator and milking machine.

1. The tractor: is a powerful and expensive multi-purpose motor vehicle used for lifting or pulling farm implements.
2. It is equipped with a governor system.
3. It has a power-take off (PTO) shaft used in drawing farm implements like ploughs, harrows, harvesters, planters e.tc.
4. It has hydraulic control system which lifts mounted implements under the control of the operator.
5. It consists of an internal combustion engine which uses diesel or petrol without spark plugs
6. It has four whells with rubber tyres.
7. Common makes and model of tractors are: David Brown, Massey Ferguson, Ford and Fiat.

Functions/uses of the Tractor

1. Tractor is used in drawing farm implements like ploughs, harrows, ridgers, planters, etc.
2. It can also be a stationery power source for equipment like shellers, threshers, grinders, etc.
3. It has hydraulic control system which aids the lifting of coupled implements.
4. It is used to carry farm inputs like chemicals, fertilizers, seeds etc. from one section of the farm to another.
5. It can also be used to carry harvested crops or other products from the farm to the market.
6. It can also be used to transport farm workers within the farm.
7. It is used to clear bush, cultivate land, plant crops, weeding and applying pesticides.
8. It can contribute to improved profitability by reducing labour costs, improving quality and quantity of produce and allow an increase in the size of the farm.

## Daily Maintenance of Tractor

Maintenance practices that can be carried out daily on the tractor include the following:

1. Keep the tractor clean by removing all trashes or mud from it at the start or at theend of operations.
2. Check water levels daily and top it when necessary.
3. Check oil level daily and top it when necessary.
4. Check tyre pressures daily before operations.
5. Inspect the tractor every day before starting.
6. Check electrolyte of battery every day and top when necessary.
7. Adhere strictly to manual or manufacturer’s instructions.
8. Do not overload the tractor, i.e, operate at appropriate speed for farm operations.

Periodic Maintenance of Tractor

Maintenance practices that should be carried out periodically or at regular intervals on the tractor include the following:

1. The tractor should be serviced at regular intervals.
2. Worn-out tyres should be replaced and tyre pressure gauged regularly.
3. Ensure that nuts, screws, or shield are checked and tightened at regular intervals.
4. Replace worn-out or weld broken parts of the tractor.
5. Adhere strictly to manual or manufacturer’s instructions. 6. Employ a competent and experienced tractor operator
6. Routine and regular changing of the engine oil.
7. Air filter should be cleared when necessary.
8. Oil filter should be changed after each service.
9. Parts like the linkages, steering and other movable parts should be greased occasionally.
10. Fuel injectors should be serviced or changed when necessary.
11. Fan belts should be replaced or adjusted.
12. Wash or clean the caburator regularly.
13. Always park the tractor in a shed.

**Bulldozers**

## Description

1. Bulldozers are powerful tractors and expensive machines with a broad steel blade or sheet at the front.
2. It has tract-type metal chains, used for its movement.
3. It consists of internal combustion engine which uses diesel or petrol.
4. The bulldozer which has track metal chains, moves by the aid of driving sprocket, track rollers and idler rollers.

Functions/Uses of Bulldozer

1. Bulldozer is used for bush clearing
2. It is used for felling trees and stumps. iii. It is used for leveling the ground. iv. It is also used to construct roads on the farms and in rural areas.

v. It is used for moving and collection of earth.

## Disadvantages of Using Bulldozers for Land Preparation

Bulldozers, because of their heavy weights and nature of work, have the following disadvantages in land preparation.

i. It destroys the structure of the soil. ii. It leads to reduction of soil fertility. iii. It also causes compaction of the soil. iv. It can cause air and noise pollution.

v The bulldozer is an expensive machine that cannot be afforded by peasant farmers. vi. It can cause soil erosion and water logging.

Maintenance of Bulldozer

The maintenance of the bulldozer is the same with that of the tractor.

3. Tree pullers

Description: The tree puller is a machine just like the tractor or bulldozer. It has the ability to move on the soil surface with minimal disturbances on the top soil. It also has a unique feature of pulling up trees from their stands with minimal disturbances of the top soil. It is recommended for use instead of the bulldozer.

## Advantages Of Using the Tree puller over Bulldozer

1. Tree puller does not compress the soil.
2. It does not remove the top soil which is very fertile.
3. The removal of soil cover is avoided, thus retaining mulching effects of vegetative cover.
4. Land is less prone to erosive forces.
5. The organic matter content of the soil is retained.
6. It leads to non-destruction of soil structure. vii. It normally uproots the trees with minimal disturbance of the soil.

4. Shellers

Description: These are machines operated electrically, mechanically or manually. It is made up of a hopper, bucket, a winder and a drum with rubber or metal spikes. Shellers are of different types, made to suit the type of crops to be shelled. It is a processing machine used to separate dry grains at 10% moisture content from the cob of maize.

Functions: Shellers are used mainly to separate the seeds from the husk or cob. In other words, shellers are used in removing the hard, ourter covering of nuts, grains (rice, maize, cowpea), etc.

## 5. Dryers

These are farm machines used to reduce moisture content of commodities such as grains, cocoa, e.tc. It operates by electricity.

## Functions of Dryers

1. It is used for drying plant materials, e.g cocoa, beans, groundnuts, maize, e.t.c
2. It is also used for drying animal products such as meat.
3. It generates heat or distribute heat which dries up or reduces moisture content of stored produce.

The dryer gets rid of moisture by:

i Increasing the temperature in the store house. ii. This leads to the formation of vapour. iii. The fanning now blows out the hot vapour.

Incubators

Descriptions: Incubators are made in varying sizes and designs. It uses different types of fuel (e.g oil lamp, electricity, etc) to supply the heat required.

Function: Incubators are machines used for hatching fertilized eggs artificially. It takes 21 days for fertilized eggs of domestic fowl to develop and hatch in incubators.

Types of Incubators include natural draught or table type and forced draught or cabinet type

Conditions for Incubator to function:

Before fertilized eggs are placed, the incubator should be run for 12-24 hours. For incubators to function properly, they require the following conditions.

1. Temperature range of 37oC – 39oC
2. Relative humidity of 50-70%; an optimum level being 60%
3. Adequate ventilation.

Components of an Incubator

An incubator is made up of setter and a hutcher. The fertilized eggs are kept in the setter for 18 days while for the remaining three days before hatching the eggs are placed in the hatcher.

The components of an incubator are:

1. Heat source – e.g lantern, heater or electric heater;
2. Control unit, damper or thermostat
3. Heat distribution unit
4. Relative humidity mediation unit which can be a basin of water, cotton – wool or humidifier.
5. Felt tray – (to hold eggs and reduce cracking) or egg racks or egg trays;
6. Thermometer – to detect the degree of hotness or coldness of the machine;
7. Fan or air circulation unit or vent for ventilation;
8. Egg turning device for regular turning of eggs; ix. Insulator, to prevent heat loss.

Problems Associated with the Functioning of the Components.

The problems that may lead to the malformation or non-functioning of the components of incubators include:

i If it is electrical incubator, power failure and irregular power supply would arise, but if it is kerosene-heat incubator, the problem that will arise include running out of kerosene.

1. Thermostat: high or low voltage or current
2. Fan – irregular power supply; overheating through over-usage; loose nuts of the parts; improper lubrication of the movable parts.
3. Thermometer: Problems include: cracking or breakage of the bulb / thermometer, loss of sensitivity.
4. Ventilation: blockage of vents.
5. Water basin – leakages; drying up of water contents. vii. Insulator – malfunctioning of the insulator unit. viii. Turning device for egg tray- lubrication of the movable joints or parts; loose nuts.

EFFORTS TO ENSURE UNIFORMITY OF HATCHING OF EGGS IN INCUBATOR;

The steps that should be taken to ensure that eggs hatch at about the same time include: i. Setting eggs uniformly in the tray

1. Timely and regular turning of eggs;
2. Ensure suitable environmental condition such as ventilation and relative humidity. iv. Proper handling of the eggs.
3. Setting eggs at the same time
4. Select eggs at the same time
5. Select eggs of the same size
6. Holding period for eggs before setting should not be more than 14 days.

OPERATIONS NEEDED AFTER THE HATCHING OF EGGS IN THE HATCHERY.

Activities or operations normally carried out after hatching of eggs in the hatchery include: i. Sexing of chicks

1. Drying of chicks
2. Intra-ocular (I) NDV Vaccination;
3. Sorting out abnormal chicks
4. Packing normal chicks

Milking Machines

Description

The milking machine is made up of an electric motor, vacuum pump, source of power, trap pail, vacuum controller, gauge, pap, milk tank and four teat cups

Function/Used

Milking machines are used for milking or extracting fresh milk mechanically from the udder of cattle (cow) and other milk – producing animals like sheep (ewe) and goat (doe).

How the Machine works

The milk is removed from the teat when the vacuum is applied to the outside of the teat cup liner. When the teat cup liner collapses, the teat is massaged and this action helps to prevent congestion in the teat walls and ensures regular flow of milk from the udder into the teat cups.

Milking machines are more efficient; they save labour; stop the cow from becoming strippers and reduce the danger of contamination. The quality of milk obtained depends on the care taken in cleaning and operating the machine.

Substances Extracted by Milking Machine

The main substance that is extracted like cow, ewe and goat is milk. The process by which the substance (i.e milk) collected with the milking machine is made fit for human consumption is called pasteurization.

Economic Importance kof Milk

1. It is a source of protein in food
2. It can be used in raising foster calves, lambs or children
3. It supplies minerals to livestock. iv. It is used as an extender in artificial in semination practices.

v. It is also used in the preparation of dairy products such as butter, cheese, yogourt, etc.

## Other tools/Equipment used in Dairy Cattle Farm

Common tools/equipment apart from milking machine used in dairy cattle farm include: i. Feed trough

ii. Cheese cloth iii. Milking chute

1. Health and medical tools
2. Silage fork
3. Milk test cup
4. Drenching bottles
5. Milking pails
6. Loading ramp/chute
7. Tattoing/numbering tools
8. Auger
9. Water trough
10. Control halters/ropes
11. Forage driers
12. Baler
13. Burdizzo xvii. Buckets
14. Washing scale
15. Forage harvester

Harmful contaminants of Milk in a Diary Farm

* 1. Stones/pebbles
  2. Bacteria
  3. Urine
  4. Dirts from tools
  5. Droplets from sick animals
  6. Excreta
  7. Straw/hay/silage
  8. Body hair ix. Insects
  9. Cobwebs
  10. Dusts

Precautions to be taken during milking

Precautions that must be taken in order to obtain or produce clean/pure milk include;

* 1. Thorough cleaning of animals before milking.
  2. Fore-milk must be tested with test cup.
  3. Handle milking with care. The milkers should concentrate on their work while the animal being milked should be treated with care.
  4. There should be no distractions like smoking, during milking.
  5. Milk animals in clean environment.
  6. Observe hygiene or sanitary rules.

TRACTOR – COUPLED IMPLEMENTS

These are implements which are coupled or attached to a tractor in order to enable it to perform its work. Examples of tractor – coupled implements include ploughs, harrows, ridgers, planters, cultivators, harvesters, sprayer, etc.

The Plough

Description: The plough is a primary tillage (or soil cultivation) implement. It is the first implement required in land preparation. It is mainly driven by either work animals or tractor.

Types of Ploughs

There are two main types of ploughs. These are (a) Disc plough (b) Mouldboard plough.

a. Disc plough: the disc plough is a strong implement adapted to tropical environment adapted to tropical environment where the soil contains stones, hard pans, and roots of plants. It is capable of working efficiently under these conditions. Parts of a disc plough include beam or frame, coupling point or hinge, linkage point and scrapper. Other are sledge or knife, concave disc, rotating hubs or disc bearing, furrow wheel or balancing disc, spring, standard and beam cap.

## Parts of a Disc plough and their functions

1. Beam or frame:
2. It holds disc in position or for attachment of the discs
3. It also bears additional weight for greater depth.
4. Coupling point: This provides point of attachment to the tractor or work animal.
5. Scrapper: it helps to remove soil or mud that cling to the disc.
6. Concave disc or Disc: (i)it rotates and makes vertical and horizontal cuts as the tractor moves forward (ii) it also inverts the soil.
7. Disc Bearing: it holds the disc and allows its continuous rotation.
8. Furrow Wheel: it provides a balancing effect for the plough as it supports both the vertical and side thrusts.
9. Spring: it acts as shock absorber for the plough during movement.
10. Standard: it holds the disc firmly to the beam.
11. Beam cap: it covers the hollow end of the beam.

## Advantages of Using Plough

The advantages of using disc plough over mouldboard plough in the tropics/West Africa include:

1. Disc plough is capable of working heavy soil, tilling and moulding heavy soil.
2. The disc plough is designed to roll over stumps and obstacles which may easily damage the edges of mouldboard plough.
3. Roots of trees that grow extensively deep in the soil are easily removed by disc plough.
4. Disc plough makes deeper cuts than mouldboard plough.
5. Disc plough buries weeds more completely than mouldboard plough.

## Disadvantages of Using Disc Plough

1. It causes soil compaction due to its heavy weight.
2. It may results in soil erosion.
3. It leads to destruction of soil structure.

1. Mouldboard Plough

Description: The mouldboard plough is also a primary tillage implement used for land preparation. It is adapted for use in temperature or light soil where there are no rocks hard pans and plant roots. The mouldboard is not as strong as the disc plough.

Parts of the mouldboard plough include: beam or frame, coultier or vertical disc, share or share point, mouldboard and standard.

Parts of a Mouldboard Plough and their Functions

1. Beam or Frame: it carries the plough and other components and provides additional weight for greater depth.
2. Coultier or Vertical Disci: It makes vertical cuts/furrows.
3. Share or Share point: This makes horizontal cuts and uproots weeds.
4. Mouldboard: (i) It carries the soil (ii) It inverts the weeds or exposes the roots of weeds.
5. Standard: It bears the mouldboard and share.

## Advantages of Using Mouldboard Ploughs

1. It can only be used in temperature soil or light soil.
2. It can also be used in soil free from stones, stumps and hardpans.

## Disadvantages of Using Mouldboard Ploughs

1. It cannot be used very well in tropical environments.
2. It is not as strong as the disc plough.
3. It looses its share point when in contact with an obstabcle.
4. It predisposes soil to erosion.
5. Soil compaction takes place when used often.

## General Functions of Disc and Mouldboard Ploughs

1. The plough bites the soil and turn it over to form soil clods or lumps.
2. They can be used to control weeds.
3. Their work helps to improve the aeration of the soil.
4. They bury plants and crop residues, thereby improving the fertility of the soil.
5. They help to mix the soil together.
6. They improve water-infiltration capacity which increases the water content of the soil.

2. Harrows

Description: Harrow is a secondary tillage implement also used for land preparation. It can also be driven by work animals or a tractor. It is used immediately after ploughing and before ridging. The harrow is an instrument designed to break up soil lumps and level the surface after ploughing.

The Popular type of harrow is the disc harrow. It works on the same principles as the disc ploughs. The disc harrow consists of numerous small discs, spaced closer on a common shaft to form a gang. There may be one or two pairs of gangs working in the same direction or in opposite direction.

Important parts of a harrow are handle, drawbar, scrappers, steel discs or discs and wheels.

## Function/Uses of Disc Harrow

1. It helps to break up soil lumps created by plough.
2. It pulverizes the soil and puts it in better tilth or fine particles and levels the soil.
3. It is used to remove weeds.
4. It is used to cover seeds and fertilizers with soil.
5. It helps to spread organic manure on the field and mixes them with soil.

Spring – tine Cultivator

Description: The spring-tine cultivator or simply harrow is also a secondary tillage implement used for land preparation. This implement can be used immediately after ploughing and before harrowing or ridging.

It consists of a rectangular beam in which strong, pointed and vertical stalks are attached. The vertical stalks are bent forward to enable it till the soil and withstand obstacles within the soil. The vertical stalks help the tine to overcome obstruction because it is strong, pointed and bent forward.

## Functions/Uses of spring – tine Cultivator

1. It helps to break down large soil lumps or clods which remain after ploughing.
2. It aids weed combining, i.e, removal of weeds from soil surface.
3. It helps in dragging of roots and stones out of the soil.
4. It can also be used for weeding and fertilizing.
5. It helps to stir the soil without turning it over.

## Ridgers

Description: The ridger is a secondary soil cultivation implement used for land preparation. The ridger is used after harrow and before planter. There are two mains types of ridgers.

These are disc and moldboard ridgers. Both work on the same principle, but disc ridgers, like all disc implements, are better adapted to tropical environments.

There are five disc in the ridger, two disc in each part facing each other. It has a strong metal beam linking all the discs. The beam is connected through strong frames to a point of attachment to the tractor. The shape of the ridger is longitudinally symmetrical.

The implementation is made entirely of strong metal. Important parts of the disc ridger include coultier, scrapper, standard and coupling point.

## How the Disc Ridger works

There are two sets of opposed single discs. Two discs in each set help to make two full ridges while the remaining discs on each set make half a ridge. Thus a total of two full ridges are made on each trip. On coming back, three full ridges and one half ridge are made.

## Functions/Uses of the Ridger

1. Ridgers are used mainly to make ridges.
2. It eases the penetration of roots and tubers of crops after use.
3. It helps to control erosion and improves aeration.
4. It eases the percolation of water after use.
5. It prevents the growth of weeds after use.
6. It collects together rich top soil, thus increasing nutrient availability.
7. It also facilities the harvesting of root crops.

Maintenance of Plougs, Harrows, Cultivators and Ridgers

1. Keep implements clean by removing all trashes and mud from it at the start and at the end of operation.
2. Ensure that nuts, caps, screws or shields are tight.
3. Grease metal joints or bearing regularly.
4. Adhere strictly to manual or manufacturer’s instructions.
5. Replace worn-out parts.
6. Keep implements in cool and dry sheds.
7. Employ a competent and experienced tractor operator to ensure the use of these implements properly.

Planters

Description: The planter has a large container or hopper. It also has a ratchet and an agitator inside the container. Also present are spaced couters or furrow openers in front of the hopper. There is also a furrow-covering device behind the hopper and a roller behind the furrow-covering device. There are two long handles for the operator. The whole equipment is mounted on two wheels.

Functions: These are machines or implements designed primarily to plant seeds of crops such as cotton, maize, guinea corn, rice and beans or cowpea.

## Types of Planters

1. Broadcast Crop Planter: This is designed to plant seeds by random scattering of seeds about the field.
2. Row Crop Planter: This is designed to plant seeds along the rows in a ridge.
3. Precision Planters: This is designed to place the correct number of seed(s) into a hole with regular spacing within and between rows.
4. Grain Drill Planters: This is designed to place the correct number of seeds into the soil and space them between rows, but not within rows.

## Parts of a Planter and their Function

1. **Handles**: They aid the operator to direct or control the planter.
2. **Furrow Opener or Hole Digger:** It digs holes in front into which the seed(s) drops.
3. **Seed Hose or Seed Tube:** It conducts or directs the seeds from the base of hopper into the hole dug.
4. **Seed box or Seed Hopper:** it contains the seeds to be planted.
5. **Furrow (Wheel) Press/Roller:** It presses the soil to cover the seeds dropped into the hole.
6. **Marker:** This traces the next furrow.
7. **Roller:** it presses down the soil to cover the seed(s) planted.
8. **Coupling Point:** This serves as point of attachment to the tractor or the work animal.
9. **Wheels:** It aids the movement of the planter.

Maintenance of the Planter

1. A planter should be used for the purpose for which it is meant.
2. It should be dismantled and washed or cleaned after use.
3. It should be stored under cool, dry environment
4. Metal parts should be oiled or greased to prevent rusting.
5. Bolts and nuts should be inspected and tightened regularly.
6. Replace worn-out parts
7. All movable joints should be lubricated.

## Harvesters

These are machines or implements designed primarily to facilitate the process of harvesting various crops.

**Types of Harvesters**

## Mower

This is used to clear weeds and other low or smaller grasses

It can also be used to harvest forage grasses for hay and silage making.

## Forage Harvester

It is used to harvest and chop green row crops. It combines the work of both row binder and silage cutter.

It removes the drudgery of lifting and loading of several tons of green bundles of maize per hectare.

It produces silage at a reduced cost.

It prevents the loss of moisture on the forage.

## Combined Harvesters

It combines the function of harvesting of and threshing of grain crops.

It also separates the grains from the cobs or straws.

It also cleans the grains by separating them from the chaff.

It ensures the passage of the grains and chaff through different nozzles.

## Sprayers

These are types of equipment designed to spray certain chemicals in various farm operations.

## Types of Sprayers

Types of sprayers include hand gun, knapsack sprayer, motorized sprayer, boom or tractor-mounted sprayer or electrodial and helicopter-mounted sprayer.

1. **Knapsack (Pneumatic) Sprayer**: The pressure needed to spray chemical is provided by hand, i.e it is a hand-operated sprayer.
2. Tractor-Mounted Sprayer: This is mounted behind the tractor during spraying.
3. Helicopter-Mounted Sprayer: This is mounted on a helicopter which sprays over a large area of land.

Description of Knapsack Sprayer

This sprayer is made of plastic, steel or galvanized iron. It is made up of a tank, a pump and a spray nozzle. It uses compressed air to drive the spray. It may be tractor-coupled or manually-operated.

Functions of Sprayers

1. Sprayers can be used to control the growth of weeds through the use of herbicides.
2. It is also used to control insects through the use of insecticides.
3. It is also used to spray disinfectants on livestock houses and structures. iv. It can be used for light irrigation or watering of vegetable beds.

v. It can be used to spray liquid fertilizers and pesticides

Maintenance of Sprayer

1. It should be properly rinsed with water after use to get rid of left-over chemicals.
2. Clean the nozzle and rinse with water to remove left-over chemicals.
3. Keep in cool, dry place.
4. Turn upside-down after use or cleaning
5. Operate according to instructions.

SIMPLE FARM TOOLS

These are simle, handy tools used mainly by peasant farmers. They are designed to help the hands to apply force in farm operations.

Some common simple farm tools and their functions are discussed below.

Cutlass: this is the tool most commonly used by farmers. There are two main types- one has a slightly curved blade with a short wooden handle, while the other has a straight metal blade and a short wooden handle. One edge of the metal blade is sharp and the other is blunt.

Function/Uses

1. For cutting down and clearing bushes and trees.
2. For transplanting seedlings.
3. For planting seeds and harvesting crops. iv. For weeding farmlands.

Maintenance practices

1. Cutlass should be sharpened regularly
2. Keep it in a dry and cool place
3. Metal parts should be oil or greased before storage
4. It should not be left lying about.

HOE: The hoe consists of a metal blade which may either be rounded or slightly rectangular in shape with a wooden handle which can be either long or short.

Types of Hoe

There are two types of hoe. These are:

1. West African Hoe: it has a short wooden handle and a round metal blade. Its metal blade is attached to the wooden handle with a prong.
2. West Indian Hoe: It has a long wooden handle and a rectangular metal blade. The metal blade has a loop round its handle.

## Similarities and Difference between West African Hoe and West Indian Hoe

Similarities

Both types of hoe have a metal blade.

Both types of hoe have a wooden handled. Differences

S/N West African Hoe West Indian Hoe

|  |  |
| --- | --- |
| i. Has a short handle | Has a long handle |
| ii. Has a round metal blade | Has a rectangular metal blade. |

1. Blade is attached to wooden handle with Blade is attached to handle by a loop a prong. The handle round the handle

Function/Uses

* 1. Hoe is used for land preparation.
  2. It is used for making ridges and heaps
  3. For planting or transplanting some crops.
  4. For harvesting some crops
  5. It is used for weeding

Maintenance Practices

* 1. Sharpen blunt blades
  2. Keep in dry and cool places
  3. Oil or grease metal blade before storage
  4. Clean or wash after use.

Spade: Spade has a long wooden handle and a broad metal blade. The edge of the metal blade is sharp so that it can easily be driven into the soil.

Function /Uses

* 1. Spade is used for lifting the soil and completely turning it over.
  2. It is used for leveling the soil.
  3. For digging holes during transplanting
  4. For mixing cement/concentrate for farm structures.

Maintenance Practice

* 1. Store in a dry and cool place.
  2. Keep away from rain and termite attack on wooden handles
  3. Sharpen the blade regularly.

Shovel: is just like the spade. It has a long wooden handle but the blade of a shovel is hollow and broad with a rectangular or round edge.

Function/Use

* 1. It is used for lifting or transferring **soil** from one place to another
  2. To load materials from ground level into wheel barrow.
  3. For making garden paths. iv. For leveling the ground and removing stones or rubbish.

Maintenance practices

* 1. Store in a dry and cool place
  2. Oil, grease or paint metal parts. iii. Keep the wooden part away from the attack of termites. iv. Clean after use.

Garden Fork: Garden fork usually has four prongs or teeth which taper to a point. The prongs, made of hard metal are about 20cm long, mounted on a long wooden handle of about 70-80cm long.

Functions/Uses

* 1. It is used for turning manure during compost making
  2. It is used for loosening the soil before transplanting iii. It is used for loading manure

1. It is used for loading hay.

Maintenance Practices

* 1. Apply grease to avoid rusting
  2. Clean after use.
  3. Keep in dry and cool place
  4. Paint metal parts before long storage.

Hand Fork: The hand fork consists of a piece of metal with three or four short flat prongs. Some have short wooden handle while others are entirely made of metal. It is mainly used in squatting position because of its small size.

Function/Uses

* 1. It is used for loosening surface soil or breaking soil clods.
  2. It is used for light weeding.
  3. For mixing small quantity of soil or manure
  4. For working manure into the soil.

Maintenance Practices

* 1. Store in a dry cool place.
  2. Paint, oil or grease to prevent rusting. iii. Clean or wash after use.

Hand Trowel

Hand trowel is a small hand tool consisting of a short metal handle and a scoop – shaped blade. Like the hand fork, it is mainly used in squatting position because of its small size. The curved metal blade makes it possible for a small ball of earth to be carried with the seedling during transplanting.

Functions/Using

* 1. It is used for transplanting seedlings;
  2. For fertilizer or manure application. iii. It is used for nursery practices or light weeding. iv. It is used for digging holes for planting.

1. It is used for sampling soil/mixing soil and fertilizers.

Maintenance Practices

1. Clean or wash and dry after use.
2. Straighten bent blade. iii. Sharpen blunt blade
3. Store in a termite-free area.
4. Store in a cool, dry place.

Rake: Rake consists of a long, wooden handle and a strong metal head with several stout prongs.

Functions/Uses

i. It is used for leveling or spreading soil surface after hoeing. ii. For removing stones and weeds from seed-beds;

1. For covering vegetable seeds when they are broadcast;
2. For breaking up soil lumps into finer particles

Maintenance Practices

1. Clean or remove dirt after use
2. Store in a dry, cool place
3. Keep away from termite attack on the wooden handle
4. Oil metal part.

Axe: axe consists of a strong wooden or metal handle onto which a solid, flat and heavy metal blade with a sharp ned edge is inserted. Larger axes as held in both hands when in use.

Functions/Uses

1. It is used for felling trees,
2. For slicing wood/splitting wood
3. For cutting wood
4. For uprooting stumps
5. For cutting firewood and logs.

Maintenance Practices

1. It should be sharpened regularly
2. Store in a dry, cool place
3. Paint, grease or oil metal parts before being put away for a long time
4. Clean after use
5. Keep wooden handle from termite attack.

Pick Axe or Digger

Pick axe or digger consists of a long wooden handle and a metal head with double blades. One blade is shaped to form a short and rather narrow hoe while the other side of the head is shaped into a small narrow axe-like blade.

Functions/Uses

1. It is used for the removal of roots of trees, (stumping)
2. For tilling of very hard soils iii. For making ridges;

iv. For tilling soil for farm-buildings erection

Maintenance Practices

1. Clean or wash after use
2. Sharpen blade regularly
3. Keep in cool, dry place
4. Keep away from rain to avoid rusting
5. Store in termite free areas. vi. Paint, grease or oil metal parts.

Head pan: is a metal container with small circumference at the bottom but a larger one at the top. It has two handles which are opposite to each other.

## Functions/Uses

1. It is used for the collection of harvested crops.
2. It is used for transplanting seedlings;
3. For carrying and mixing manure/fertilizers
4. For carrying farm inputs and outputs

## Maintenance Practices

1. Wash or clean after use
2. Paint or oil before being stored for a long time
3. Keep in a cool, dry place
4. Keep away from rain.

Watering Can: This is a metal or plastic can fitted with a spout which has a performed metal sheet called rose, over its mouth. The rose is removable after use and replaceable when needed. It also has two handles used for lifting or carrying the can.

Function/Uses

1. It is used for light irrigation, like, application of water to crops during the dry season.
2. It is used for the application of liquid fertilizers.
3. Application of water to seedlings in the nursery or vegetable beds. iv. It is used for watering cement blocks used for constructing farm house.

Maintenance Practices

1. Wash and keep dry or clean after use to prevent rusting.
2. Store or hang upside down.
3. Keept the nozzles free from blockages
4. Store /keep in a cool-dry place.
5. Rinse with water if used for liquid fertilizers.

## Mattock

Mattock consists of a small wooden handle and a double-headed metal head. The mattock is essentially a small axe and hoe combined in one.

Functions/Uses

1. It is used for digging and uprooting small stumps
2. It is used for loosening of stones, roots and hard plants in the sol and digging of soil
3. It is used in clearing bush and weeding farms

Maintenance Practices

1. Clean after use
2. Store in a cool, dry place.
3. Sharpen metal blade
4. Paint, grease or oil metal parts before storage for a long time.

Pruning saw

Pruning saw is flat and made of flexible metal , its handle is wooden. Both edges of the saw have sharp pointed teeth.

Function/Uses

1. It is used for cutting wood or log
2. For pruning operations
3. For falling of trees
4. It is also used for cutting of budded seedlings.

Maintenance Practices

1. Sharpen the teeth regularly
2. Grease or oil metal parts before storage
3. Store in a cool, dry place

Sickle: The sickle has a curved blade fitted to a short handle. The inner edge of the metal blade is sharp while the outer edge is blunt.

Function/Uses

1. It is used for harvesting fruits/cereal crops
2. For cutting grass pasture for animals
3. It can also be used for light weeding of vegetable plants

Maintenance Practices

1. Sharpen the inner edge/blade regularly
2. Store in a dry, cool place iii. Paint or oil before storage for a long time.

Harvesting Knife

Harvesting knife has a very long wooden pole or handle with a small curved metal blade at the end. It also has a short, strong blade close to the curved end.

Functions/Uses

i. It is used for harvesting some crops e.g cocoa, oil palm, mango, orange, kolanut, etc. ii. It is also used for light pruning.

Maintenance practices

1. Keep away from rain to avoid rusting
2. Keep in termite free area
3. Sharpen the blade regularly
4. Oil or grease the metal parts before storage.

Root-loading fork

This tool is similar to the garden fork except that the prongs are usually bent at angle to the wooden handle.

Function/Use

It is used mainly to load roots, hays or silage into carts or wheel barrows

Maintenance Practices

1. Store in a dry, cool place
2. Clean after use
3. Keep away from rain or moist place to avoid rusting
4. Grease or oil metal parts before storage for a long time

Hay Fork

Hay fork has two or three long, round and curved tines (or prongs) with a long wooden handle.

Function/Uses

The tool is used for collecting and removing hay and livestock bedding. The fork is inserted vertically in the middle of the load and the load is carried with the prongs held upwards.

Maintenance Practices

i. Store in a dry, cool place, ii. Clean or wash after use iii. Grease or oil metal parts before storage for a long time.

Manure Drag

This tool has four or five tines, shaped like those of a garden fork but with the pointed ends at right-angles to the handle to facilitate digging.

Functions/Uses

1. It is used for digging farm-yard manure
2. It is also used for unloading farm-yard manure

Maintenance Practices

1. Keep in a dry, cool place
2. Oil or grease metal parts before storage
3. Keep away from rain or moist places to avoid rusting.

Wheel barrow

The wheel barrow is a large meal or wooden container with one wheel at the front, two handles at the rear and below these, are two legs which support the container. It is pushed by raising the rear end slightly so that the main weight is taken up by the front wheel. Tools which can perform the same function as the wheel barrow include headpan, bucket, tractor – mounted container and container driven by work animals.

Functions/Uses

1. It is used for carrying farm inputs e.g fertilizers, seeds etc
2. It is used for carrying farm outputs e.g harvested crops, slaughtered animals e.t.c
3. It is used for transplanting seedlings
4. It is also used for carrying load/materials to the market.

Maintenance Practices

i. Clean the tool after use ii. Replace worn-out parts

1. Paint the tool if necessary
2. Store in dry, cool place
3. Tighten bolts and nuts on wheels properly.

Crowbar

This is an iron bar 90-120cm long and bent slightly at one end.

Function/Uses

1. By inserting the pointed end underneath a load and pushing the long end down wards, the load can be gradually moved.
2. It is also used for digging holes for planting seeds.

Maintenance Practices

1. Keep in a cool, dry place.
2. Grease or oil the metal part before storage for a long time. iii. Keep away from rain to avoid rusting.

Bradawl

This is s a small tool with a wooden handle. It has a short, round blade with a small, narrow cutting edge;

Functions/Use

It is used for boring holes in wood

Maintenance Practices

1. Store in a cool, dry place
2. Keep away from rain and sun
3. Sharpen the tool regularly.

Budding Knife

Budding Knife is a small knife with a short, wooden handle and a short, metal blade which is sharpened at one edge.

## Function/use

Budding knife is used mainly in budding by vegetative propagation in citrus, cocoa, rubber etc.

## How the tool is used

An inverted T-shaped cut is made with a budding knife in the bark of the stock plant, about 20cm above the ground level. The bark on either side of the cut is lifted slightly to admit the bud, which is pushed into position so that the layers of both the scion and the stock are in close contact.

Maintenance Practices

1. Sharpen the metal blade regularly.
2. Store in a cool, dry place
3. Use for the purpose for which it is meant.

## Emasculator

This is an instrument for castration of some farm animals. It consists of a pair of powerful pincers with plastic or metal handles. The pincers press the neck of the scrotum to crush the spermatic cord which supplies blood to the tests.

Function/Use

The Emasculator is used to castrate some farm animals, especially the males, e.g bull, ram, doe (goat)

Maintenance Practices

1. Keep clean always
2. Use according to instructions
3. Employ the service of an expert
4. Keep in a cool, dry place.

Shears

The shears are in enlarged pair of scissors or, are scissors-like in shape. They possess two long metal blades and two handles which may be wooden, metal, rubber or plastic. The blades are sharpened at one edge and are connected to the pivot by bolt and nut.

Function/Use

1. Shears are used for pruning operations
2. They are also used for trimming flower hedges. iii. They can be used for cutting flowers.

Maintenance Practices

1. Store in a cool, dry place
2. Sharpen the blades properly
3. Keep away from rain to prevent rusting
4. Clean or wash after use.

## Secateurs

It is scissors-like in shape but small in size. It consists of two short, metal blades-one with a concave curve and the other with a convex curve joined as a pivot by bolt and nut. It possesses two short wooden or metal handles. It usually has a spring between the handles.

Function/Uses

1. It is used for pruning shrubs, ornamental plants and for weeding.
2. It is used for trimming hedges or shrubs
3. It is used for cutting bud, wood or scion and the root stock.

Maintenance Practices

1. Metal blades should be washed or cleaned after use
2. Blades should be sharpened when necessary
3. Keep in termite-free area to protect wooden handles
4. Tighten bolt and nut when loosened.
5. Store in a cool, dry place.

Hammer

Hammer is a tool with a heavy, metal head on a short wooden handle. The metal head has two ends-one is the flat ball end and the other end is prong-like.

Function/Use

1. Hammer is used for straightening damaged or bent components of farm

implements.

1. It is used for driving nails into the wooden parts of farm structures/equipment
2. The ball end is used for riveting. iv. The prolonged end is used for removing nails from wood.

Maintenance Practices

1. Keep in dry, cool place.
2. Store in termite-free area to protect wooden handle
3. Grease or oil metal part before storage for a long time.

Mallet

The is a wooden hammer with a short handle and a large wooden head. The shape is just like the normal hammer except that it is larger but lighter than the metal harmer.

Function/Uses

1. It is used for driving a chisel while cutting or shaping wood
2. For hammering materials that would be damaged by a metal hammer.

Maintenance Practices

1. Keep in a cool dry place
2. Use only for intended functions(s)
3. Keep away from rain and termite infested area. iv. Store in tool box.

Pliers

A pair of pliers is a small metal tool with jaws which normally have parallel toothed surfaces, used for gripping.

Functions/Uses

1. It is used for gripping firmly and for twisting wires;
2. For holding or handling bolts and nuts
3. For handling small objects;
4. For cutting, especially wires and other cables.

Maintenance Practices

i. Store tool in a dry, cool place. ii. Oil or grease metal parts.

Spanner

A spanner is a hand tool which consists of a small bar of steel having an open or close grip or jaw at one or both ends. This fits over or clamps the head of a bolt and can be used either to turn it or hold it in position.

Some spanners are adjustable.

Functions/Uses

1. It is used for loosening nuts/bolts on farm machines
2. For tightening nuts on farm machineries

Maintenance Practices

1. Keep in a dry, cool place
2. Keep away from moist areas or rain to avoid rusting
3. Grease or oil before being put away for a long time.

Screw driver

This is a small tool with a wooden or plastic handle and a pointed or narrow metal rod. It has a blunt end which is either flat and straight or star-shaped.

Functions/Uses

i. It is used for turning or screwing nails or screws into or out of wooden or metal surfaces. ii. Some are used to detect the presence of electric current.

Maintenances Practices

1. Keep away from rain to avoid rusting.
2. Keep in a cool, dry place
3. Oil or grease metal parts, if it is to be stored for a long time.

Nut and Bolt

A bolt is a piece of metal consisting of a rod with a head at one end and a threaded area at the other end .

Function/Use

Both bolt and nut are used for holding two pieces of metals or wood in postio in farm machineries or structures.

Maintenance Practices

1. Keep properly in tool box
2. Keep bolt and nuts in a cool, dry place. iii. Keep away from rain to avoid rusting.

iv. Use the appropriate bolt for a nut.

Screw: A screw is a piece of metal consisting of a pin threaded 2/3 with a pointed end. The other bigger end has a narrow hole or cut on top in which a flat screw driver can fit in during use.

Function/Use

It is used to hold two or more pieces of metals or wood in position in farm machineries, equipment and structures.

Maintenance Practices

1. Keep tool in a cool, dry place
2. Rub with oil or grease to prevent rusting. iii. Use appropriate plier to screw in or screw out to avoid it wearing out.

File or Chisel

This has a straight steel blade with a sharp cutting edge. It is about 20-30cm long with a wooden handle.

Function/Uses

i. It is used for sharpening blades of farm tools. ii. It is used for smoothening rough surfaces of farm implements.

Maintenance Practices

1. Keep in a cool, dry place
2. Store in termite-free area to protect wooden handle. iii. Grease or oil metal parts before storage for a very long time.

Questions:

1. What is farm Machinery
2. State five farm machines
3. State five farm implements
4. State five maintenance of a tractor

**WEEK 4 & 5**

**SURVEYING AND PLANNING OF FARMSTEAD**

## MEANING OF FARM SURVEYING

Farm surveying is defined as the process by which measurement of land is made on the farm.

Such measurement by tables, plans or layout are done for specific purposes. It can also mean the measuring and mapping out of the position, size and boundaries of an area of farm land.

## Importance of Farm Survey and Planning in Agriculture

1. It helps to determine the hectarage of land
2. Farm surveying exposes the gradient of the land.
3. It helps in determining the amount of input of Labour, seeds, fertilizers and chemicals to be used in the farm
4. It helps the farmer to make decisions on locations of various farm buildings and structures.
5. It enables farmers to make the best use of available resources in order to achieve maximum profits.
6. Loans can be got with the help of farm survey plans
7. Farm survey gives the owner of the land security.
8. It does not allow for wastage of land.
9. It helps to determine the yield or productivity of crops.
10. Farm surveying and planning can be used as a basis of feasibility studies.

## SOME COMMON SURVEYING EQUIPMENT/INSTRUMENTS

Some common surveying equipment or instrument include

1. Ranging pole;
2. Gunter’s chain
3. Measuring tape
4. Prismatic compass
5. Theodolite
6. Arrows or pin;
7. Offset staff
8. Beacons or pillars

## Ranging poles

1. Ranging pole is made of wood or metal
2. It is of varying lengths e.g 1.8m, 2.4m or 3.0m
3. It is generally circular in section, though some octagonal types are obtainable.
4. It is usually painted black, bright red and white to enable it to be seen from a distance.
5. It has a pointed end.

Function/Uses:

i. It is used for making stations. ii. It is also used for marking straight lines.

Gutter’s Chain

1. It consists of a series of dumb bell-shaped links of steel wires joined together by three small rings.
2. It has brass handles at either side.
3. It is divided into 100link so that each link is 19.8cm or 7.92i ins.
4. One Gunter’s chain is normally 20.13m (66ft) in length
5. A link is the distance from the middle of the central ring to the middle of the next central ring. vi. The chain is entirely metallic.

Precautions that should be Taken when chaining a farmland.

1. Pull taut chains, tapes or ropes.
2. Avoid errors of transposing figures on papers
3. Equipment such as theodolite should be placed on a perfect horizontal plane. iv. All chains, tapes, ropes etc. must be properly aligned before taking measurement.
4. Avoid error of parallax when reading measurement
5. Make sure the chain is not faulty before use.

**Functions/Use:** It is used in taking short or detailed measurement of length and breadth.

## Measuring Tapes

**Description:** (i) it is usually made of linen or fine steel sheet. (ii) It is usually marked on one side with metric units and the other side with the imperial unit. (iii) The tape is of various types and lengths. (iv) The tape is normally wound in a small case from where it is unwound for use.

**Function/Use**

It is used for taking measurement of length, breadth and height.

## Arrows or Pins

**Description:** (i) These are thin pointed steel wires of about 30cm long with one end curved into a ring. (ii) A red cloth is normally attached to the ring so that it can be seen from afar.

**Function/Uses:** (i) It is used during chaining for making off chain lengths as measured.

(ii) It can also be used for marking stations.

## Offset Staff

**Description:** (i) this is a graduated rod-3m long. (ii) A hook may be fitted at the top for the purpose of pulling a chain through a hedge. (iii) Each telescopic link is 0.3m (30cm) in length.

**Function/Use:**  (i) it is used for taking short offset measurements.

## Beacon or Pillar

**Description:** (i) it is made of rectangular block usually in concrete form. (ii) Marks are usually inscribed on top of the block. (iii) The beacons are always buried in the ground with marked head raised a little above the ground.

**Function/Uses:** (i) It is used for marking off points measured. (ii) It is also used for the recognition of the measured or surveyed area.

## General Maintenance of Surveying Instruments

1. All instruments must be clean after use.
2. Keep instruments in dry and cool places.
3. Those with metal parts should be oiled or greased or painted before they are put away for a long time.
4. Keep instrument away from heat and rain to prevent damage and rushing respectively.
5. Replace worn-out parts.
6. Use instrument only for the intended functions.
7. Let competent surveyor handle and use the instrument only or as he may direct.

## MEANING AND IMPORTANCE OF FARM PLANNING

Farm planning is a drawing or outline of a farmstead. It also involves the proper land use planning, i.e., putting the land into use for which it is best suited without the risk of land degradation.

## Importance of Farm Planning

1. It enables the farmer to make proper use of land.
2. It also ensures the proper sitting of certain building or structures in certain locations within the farmstead.
3. It ensures the location of livestock building in relation to other farm building.
4. It promotes the neatness and prevents pollution within the farmstead.

## FACTORS NECESSARY FOR PLANNING A FARMSTEAD

**Definition of a farmstead:** Farmstead can be defined as a farm house and all its production and processing structures. A farmstead is both a home and a production centre. In other words, a farm stead is the farmer’s dwelling place and production centre. Its planning is based on the system of farm, and on the need and comfort of the farmer’s family.

**Factors Influencing the Siting of Farms or Farmstead.**

In planning a farmstead, the following factors must be considered.

**Topography:**

Topography determines the location of farm building and structures.

Farm building or living quarters are usually located on high elevations for proper viewing of the farm.

Animal quarters should be located far from the staff living quarters

Locate crops such as vegetables on low lying areas where moisture contents is high.

Fish ponds are located on sloppy grounds Irrigation farms are best sited on flat grounds **Soil Type:**

Crop farms are sited on soils that are fertile

Pastures are sited on less fertile soils

Farms building and structures are best located on poor soils.

Farm roads are best constructed on well drained poor soils.

## Accessibility

Locate facilities within walking distance

Provide good roads to facilitate the transportation of farm inputs Ensure easy accessibility and evacuation of farm produce.

Good accessibility makes marketing of farm produce possible.

## Water supply

Adequate water supply is needed for human and animal use

Livestock structures should be located close to source of water supply for easy cleaning

Water is required for irrigation purpose.

## Health/Hygiene

Erect livestock units against wind direction

Locate animal units far away from human residential houses to avoid health hazards.

## Nearness to Market

Nearness to market reduces distribution or transport cost.

It exposes products to many buyes

It reduces the need for farm storage.

## Drainage

Adequate drainage is important to avoid water-logging

Gentle slope facilitates proper drainage

Good drainage makes movement easier within the farm.

## Reasons for Planning a Farmstead

It allows for proper utilization of resources without wastage.

It makes the farmer to be more responsive to market demand.

It encourages efficiency of farm activities

It makes coordination and control of farm operations easier.

## PRINCIPLES OF FARMSTEAD LAYOUT

Some specific principles are required for farmstead layout and these include:

Plant the crops on the best soil within the farm.

Livestock building should be located on the poorest soil within the farm.

Buildings should be located in easily accessible areas.

Farm building should not be located on slopes to avoid erosion.

Residential and office buildings should be located far away from livestock building to avoid the noise and unpleasant odour from farm animals wastes and dungs.

## CALCULATION OF AREA OF FARMLAND AND PLANT POPULATION

The shape and size of any farmland can be measured or determined by farm surveying. The area of farmland varies; some are rectangular, square, triangular or even circular in shape. The formula used in the calculation of farmlands and plant population include:

1.  **Area of farmland:**  This refers to the product of the length and width of the farmland measured in metres. Mathematically,

Area of Farmland = Length x Width (metres)2

i.e (L x W)m2

## (b) Number of plant stand/plant population

This refers to the number of plants in an area of farmland. Mathematically,

Plant population = Area of farmland (m2)

Spacing (m2)

1. **Spacing:** This is the distance between one crop plant and the next plant which is usually between and within the rows, e.g., 60cm x 30;-100cm x 75cm, etc.
2. **Note: one hectare = 10,000m2.** This figure means there are 10,000m2 in one hectare of are of farmland is given in hectare.
3. **Measuring the Area of Farmland:** The shape and size of my farmland can be measured or determined by farm surveying. They are of farmland varies a already noted above.

**Formulae for calculation the area of farmland are shown below.**

## FARM SHAPE OUTLOOK AREA

|  |  |  |
| --- | --- | --- |
| Square side (s) | **S** | **S2** |
| Rectangle length, width | **W**  **l** | **L x W** |
| Triangle Height, Base | **h** | **bh** |
| Circle radius |  | **2**  **3.142** |

Trapezium **(A+b)h**

**Example 1:** if the length and width of a farmland are 60m x 30m respectively, and the spacing of a tomato crop plant is 30cm x 30cm, calculate (a) the area of the farmland; (b) the plant population (tomato) in the give area; (c) the total population if there are two plants per stand.

60m

30m

**Shape of a farm Land**

## SOLUTION

1. Area of farmland = Length x Width

= 60m x 30m = 1800m2

1. Spacing of crop = 30cm x 30cm or 0.3m x 0.3m

Area of 1 stand of crop=0.3m x 0.3m = 0.09m2

No of stand/crop = Area of farmland(m2) = 1800m2 =

180,000

Spacing (m) 0.09m2 9

= 20,000 crop stands

The plant population (tomato) is 20,00 stands.

1. since there are two plants per stand the total plant population = 20,000 x 2 = 40,00 tomato plants

The total population= 40, 000 tomato plants.

Example 2: A school farm in Lagos State was surveyed and presented in a map as shown in the diagram below. Use it to answer the following questions.

B 40cm D

30cm h 30cm

A E

C F

a. What is the approximate area of the farm?

1. If the farmland is used for pineapple production at a spacing of 2.5m x 2m, what will be the initial population of pineapple trees in the farm?
2. If 8% of the pineapple plants were damaged by pests, what will be the final pineapple plants in the farm?

Solution

a. Use the formula of trapezium to solve this problem?

Area of farmland = (BD + AF) x h

But first find or calculate h, using Pythagoras theorem h(BC)2 = AB2– AC2 = 302 – 152 900-225 = 675cm.

h(BC) = = 25.9m = 26m. (Approx) Area of farmland = (40 + 70) x 26

= (110) x 26

= x 2, 860 = 1, 430m2

Area of farmland = 1,430m2

Population of pineapple trees =

= = = 286 pineapple plants x = 22.88 = 23pineapple plant damaged

Pineapple plants available in the farm = 286-23 = 263.

Final pineapple plants remaining = 263

**Questions:**

1. What is farm surveying

1. State five surveying equipments
2. What is farm layout
3. State five objective of surveying

**WEEK 6 & 7**

**IRRIGATION AND DRAINAGE**

## IRRIGATION

Irrigation is defined as the artificial application of water to soil or land for farming puposes. In other words, irrigation is the artificial application of water to the soil to supplement insufficient rainfall. Irrigation is mainly practiced in areas where there is insufficient rainfall.

Water is the most important determinant in the growth of crops. The choice of irrigation system depends on: (i) availability of water (ii) slope of land (iii) soil type (iv) typees of crops and (v) size of farmland

## Aims of Irrigation

1. To add water to the soil in order to supply moisture for plant growth.
2. To ensure the survival of crops during droughts.
3. To cool the soil and the atmosphere, thereby making the environment morefavourable for plant growth.
4. To make early planting possible.

**Importance or effects of Irrigation on crop production** The effects of irrigation on crop production are:

* 1. Irrigation softens the soil for easy tillage operations
  2. It provides moisture in the soil for root absorption
  3. It reduces the amount of salts accumulated in the top soil, which could be harmful to crop plants.
  4. It also cools the soil by reducing the soil temperature during the dry season when the soil temperature is very high. Plant growth is thus improved.
  5. Irrigation enables the crop to be well established even when rain is erratic.
  6. It increases crop productivity or crop yield
  7. Irrigation provides humid environment for the breeding of pest and pathogens of crops.
  8. It help in the improvement of microbial decomposition of organic manure to release nutrients for crop plant.
  9. Irrigation dissolves nutrients for root absorption.
  10. It assists in facilitation crop production all year round.
  11. Irrigation encourages the spread of weed seeds.

## Irrigation Systems

Irrigation systems or types can be grouped into three main classes: Surface irrigation, sub-surface irrigation and Overhead irrigation.

## Surface Irrigation

In the system, water from rivers, dams or streams flows along the surface of the land to farmland. This can be in form of channels, flooding, contour ditch, furrow, basin, border dyke, border ditch, etc. the most important condition for surface irrigation to be efficient is for the land to have a gentle slope towards the direction of the farmland.

## Advantage

1. It removes excess water caused by heavy rainfall especially in heavy soils.
2. It is easier to construct.
3. Irrigation is cheap to establish and maintain.
4. It prevents accumulation of alkalis.
5. It increases the activities of microbes in top soil.
6. It helps in the collection and disposal of surface run-off.

## Factors to be considered in choosing surface irrigation method

1. The topography or sloppy land
2. The soil type
3. The type of crop to be grown IV. The size of the farmland.

In this system, water is applied below the soil surface by maintaining an artificial water level at certain depth. This, however, depends on the type of crop and the nature of the soil. In all cases, perforated pipes are used to deliver water within the soil, and this water gets to the roots of crops through capillary action.

**Advantages:**

1. By irrigation, it is possible to maintain water at optimum depth for crop need.
2. In addition, water use efficiency is high.
3. It also ensures low evaporation losses from soils.
4. It does not create obstruction or obstacles when carrying out cultural practices **Disadvantages:**
5. Water which has a high salt content cannot be used.
6. It requires some level of expertise or technical know-how.
7. It is bit expensive

## Factors to be considered in choosing sub-surface irrigation method

1. The permeability of sub stratum
2. The level of water table III. Soil texture or capillarity IV. Soil structure.

## Overheard irrigation

In overheard irrigation system, water is supplied to the farmland above the surface of the soil. Overheard irrigation exists in two forms: Sprinkler Irrigation and Drip Irrigation.

(a) **Sprinkler Irrigation:** In this system, water is sprayed from the air and allowed to fall on the ground surface somehow as rainfall, through nozzles under high pressure. Pumping machine which operates under high pressure is needed to pump water into irrigation pipes which are spaced to ensure even distribution of water.

## Advantages of Sprinkler Irrigation

1. The amount of water supplied is regulated.
2. It economises the use of water.
3. It is suitable for high arid lands with high evapo-transpiration rate
4. Soluble fertilizers, herbicides, etc. can be applied through the irrigation water. V. It can be used for all crops except tree crops, like cocoa.

## Disadvantage of Sprinkler Irrigation

1. Sprinkler irrigation is costly to operate
2. High wind velocity may prevent distribution of water
3. A stable water supply is required
4. It requires high power to produce the high pressure needed to pump water into pipes.
5. There is lack of sufficient technical knowhow on sprinkler irrigation operation.

**(b) Drip Irrigation:** Drip or tickle irrigation is new method of irrigation where water is discharged through nozzles called emitters or drippers at selected spacing to deliver water to the soil surface near the base of the plant. With this system, loss of water through deep percolation, run-off and evaporation is greatly reduced.

## Advantages of Drip Irrigation

1. It is economical in the use of water
2. It reduces salt concentration in the root zone.
3. Fertilizers can be applied through this system
4. It operates with slower line pressure
5. It is the most appropriate system needed in arid and semi-arid areas.

## Disadvantages of Drip Irrigation

1. It is very expensive to set up and maintain
2. Water cannot be distributed in a sloppy farmland evenly III. Water with high salt content cannot be used

## Problems Associated with Irrigation

There are many problems associated with irrigation and these include:

1. Inadequate water supply for irrigation
2. Irrigation equipment is expensive
3. Pests from dry surrounding may invade and damage crops in irrigated land.
4. Disease causing organisms increase with increasing humidity
5. Vectors of disease like snails, tsetse flies breed freely in irrigated areas. VI. Irrigation equipment is expensive to maintain
6. Lack of adequate technical know-how on irrigation on the establishment and operations of irrigation scheme.
7. Excessive dissolution of salt in irrigated water prevents proper growth of corps.
8. It may lead to pollution,. If it contains dangerous chemicals
9. It disturbs the free movement of farm machinery

## How to reduce disease build up in irrigated farm

Reduction of disease build up in an irrigated farm may be achieved through:

1. Use of disease resistant varieties
2. Crop rotation
3. Use of appropriate chemicals
4. Use of clean tools
5. Use of clean or healthy planting materials
6. Destruction of disease crops to prevent its spread.
7. Avoidance of excessive irrigation VIII. Weed control

## Methods of Irrigation a small nursery

Small nursery can be irrigated through:

I. Manual sprinkling e.g. hand, brooms, brush II. Use of watering can

1. Drip irrigation
2. Channel irrigation
3. Sprinkler Irrigation

Sources of water for irrigation include rivers, lakes, streams, ponds, dams, bereholes, wells and reservoirs.

## DRAINAGE

Drainage is a process whereby excess water in the soil is removed artificially to promote good farming activities. In other words, drainage is the withdrawal of excess water from the soil while at the same time retaining adequate reserves to carry the crops through the periods of scarcity.

## Importance or effects of Drainage

The reasons for draining agricultural land include the following:

1. Drainage helps in reclaiming water logged soil for crop production
2. Drainage improves the soil structure thereby improving the water holding capacity of the soil
3. It improves soil aeration for good root respiration
4. It gives suitable conditions for the growth of soil microbes responsible for the decomposition of soil organic matter which provides nutrients for plant growth.
5. It helps to increase the soil temperature for the benefit of crop plants.
6. Draining also leaches excess salts from soil thereby preventing the death of plants arising from poisoning.
7. It make tillage operations easier
8. It reduces the incidence of crop diseases
9. It enhances harvesting of crops, especially swamp rice.
10. It enhances early planting of crops
11. Drainage makes land preparation easier
12. It reduces soil acidity
13. It increases the soil temperature
14. It increases crop production 15. It makes the soil workable or light.

16. Drainage reduces soil salinity.

## Drainage Systems

There are two major systems or types of drainage. These are surface and subsurface (underground) drainage.

## Surface Drainage

This involves the orderly removal of excess water artificially from the surface of the land, using constructed open ditches, fid drains, and land grading. Open ditches ensure easy evacuation of excess water from farmland. **Advantage of surface drainage**

1. it is relatively easy to construct
2. it is cheaper than the subsurface drainage system.

## Disadvantages of surface drainage

1. It occupies good land (space) that could have been used for planting
2. they hinder the passage of machines like tractors
3. they are prone to gully erosion
4. it requires frequent maintenance
5. it increase the cost of crop production
6. farm mechanization is impaired
7. it is expensive and difficult to establish
8. it makes the farm more prone to hazards e.g., falling into an open drain.

## Sub-surface/Underground Drainage

This is the orderly removal of excess water from the land, using tiles or moles or perforated pipes dug under the ground. These collect water and channel it away from the farm land.

## Advantages of sub-surface drainage

1. It does not pose any threat to machines
2. High value crops are grown
3. It leaves the field free from surface obstructions
4. Soil is hard in place so that it would not damage drainage pipes. V. More land is made available for cultivation
5. Cost of maintenance is low
6. Drainage is faster and more efficient

## Disadvantages of sub-surface drainage

1. It is very expensive to operate
2. It cannot be easily constructed
3. It is difficult to maintain
4. It needs very deep excavation of the soil.

Questions:

1. what is irrigation

1. state five importance of irrigation
2. what is sub-surface irrigation
3. state two advantages of sub-surface irrigation

**WEEK 8**

**ENVIRONMENTAL FACTOR AFFECTING AGRICULTURAL PRODUCTION**

## MEANING AND ELEMENTS/ FACTORS OF CLIMATE

**Definition:** Climate is defined as the average weather condition of a place, measured over a long period of time (over 35 years).

**Factors of climate:** Factors or elements of climate include (i) Rainfall (ii) Temperature (iii) wind (iv) Relative Humidity (v) Pressure (vi) Light (vii) Radiant energy.

## Importance of climate in agriculture

Climate affects the duration of a cropping season

It determines the yield of crop and animals

Climate limits the types of crop or livestock to be grow or reared in an area

It also affects vegetation distribution and soil formation

It affects the incidence of pests

It affects the incidence of diseases

## How climate determine the type of crops and animals found in Nigeria

Essential factors of climate which determine the types of crops and animals found in Nigeria are rainfall and temperature.

## Rainfall

Rainfall is define as the amount and distribution of water precipitated within a given time, in a given area

It is brought about by the South-West Trade winds which blow from the Atlantic ocean

As the wind blow from the ocean inland, it drop the water it is carrying

As a result of this, the coastal areas receive more rainfall per annum than rest of the region

As the moisture-laden wind moves further inland, the amount of rain decreases By the time this wind gets to the northern part of the country, there is little or no moisture left in it

In the northern areas, less rainfall is experienced per year

In the coastal areas, rainy season ranges from eight months to all-the-year-round while in the north, rainy season lasts for only three to four months

This moisture regime affects crops and livestock distribution

In the coastal areas, which are the more humid southern part, crops which adapt to heavy rainfall are predominant, e.g. rice, maize, fruit, cocoa, forest trees, yam, banana etc.

Much animal rearing does not take place in heavy rainfall area because of high humidity and tse-tse fly Infestation

Consequently, only animals such as dwarf sheep, goat, poultry, muturu and N’dama cattle resistant to try panosomasis can be reared

In the northern parts, with little rainfall, crops which are drought resistant, like guinea corn, millet, cowpea, groundnut, cotton, beniseed etc. are grow

These crops normally complete their life cycles within three to four months of rainfall. This area is the animal-rearing zone because of few or no tse-tse fy Animals like donkeys, cattle, sheep, goats, camels, horses, etc. are reare here successfully because sufficient grassland for grazing them

## Temperature

Temperature is defined as a measure of the heat energy which a body contains or the degree of hotness and coldness of a place at a point in time

There is variance of temperature from the coastal areas to the extreme north During the dry season, temperature is extremely high in the north but not as high in the coastal areas

Though many farming activities do not take place in the dry season, the crops found in the north are high, temperature loving plants, like tobacco

The average minimum temperature varies from 22C in the coastal areas e.g.

calabar, during the coldest month of the year to about 13C in the northern areas e.g.

Nguru, during the coldest harmattan season

Owing to this coldest, wheat can be successfully grown in the north under irrigation, while it cannot be grown in the coastal areas

Animals found in the northern area are also well-adapted to withstand the severe heat of the sun.

**Climate factors affecting agricultural production**

## Rainfall

**Definition**: Rainfall is defined as the release of excess condensed water vapors in the atmosphere into the earth.

It determines the distribution of crops and animals

It is necessary for seed germination

Excessive rainfall leads to leaching of nutrients and causes soil erosion

It helps to dissolve nutrients in the soil, thereby making the nutrients available crops

It determines the type of vegetation of an area

It determines the seasons in Nigeria i.e. rainy and dry seasons

It determines the vegetation types in Nigeria – Savanna in the north and forest in the south

The season also determines when crops would be planted

The seasons also determines the type of crops to be grown

Vegetation types in turn determines the types of livestock that can be raised in the different ecological zones

Insufficient rainfall causes crop failure and poor yield.

## Ways in which high rainfall affects agricultural production

High rainfall prolongs the cropping season

It increases the problem of plant diseases

It determines the type of crop to be grown

It increases the incidence of erosion or flooding

It encourages thick forestation thus increasing the incidence of pest e.g. tse-tse flies infestation

It encourages the growth of disease causing organisms (pathogens)

It increases leaching of plant nutrients or soil acidity

It causes water logging in clay soil

It determines the type of crops or livestock grown or reared i.e. distribution of crops and animals

It encourages faster or rapid growth of weeds **Temperature**

**Definition:** Temperature is defined as the degree of hotness or coldness of a place.

Temperature is necessary for germination of seeds

It also affects the distribution of crops and animals

Too hot or too cold temperature does not favour plants and animals growth

Unfavorable temperature may result in seed dormancy

High temperature affects evapo transpiration, and reduces the performance of livestock

It affects the wilting of field crops, ripening and maturity of crops

Temperature affects microbial activities in relation to mineralization of organic matters

High temperature leads to loss of soil nutrients through volatilization

High temperature may be harmful by causing premature dropping of fruits and sudden death of livestock e.g. heat0stress in poultry

High temperature reduces the performance of livestock.

## Wind

**Definition:** Wind is defined as air in motion.

High wind velocity may cause wind erosion

It aids seed and fruits dispersal

It can aid pollination and spread of diseases

It helps in the distribution of rainfall and changes in seasons e.g. rainy and dry season

High wind velocity causes damage to crops e.g. lodging

It determines seasons in Nigeria. For example, South West wind brings rain while

North East trade wind brings harmattan or dry season

Wind affects evapo-transpiration

Wind can cause serious damage to crops inform of lodging e.g. wind storm. **Sunlight / Sunshine**

**Definition:** Sunshine is the amount of heat and the period the sun’s rays are received at a place.

Sunlight is necessary for photosynthesis

It affects evapo-transpiration

It affects the productivity of crops due to length of day i.e. **Photoperiodism**. In other words, light divides plants into three photo period:

**Long day plants:** These plants require longer day light of between 13-15 hours of sunshine e.g. millet, sorghum (guinea corn)

**Short day plants:** These plants require shorter day light period of between 8-10 hours of sunlight e.g. cocoa, kola, oil palm etc.

**Day-**neutral plants: These place require equal period of day and night, that is about

12hours of sunshine and 12hours of darkness e.g. tomato

Light affects the rising and roosting of animals

It affects the rate of production in poultry

It determines the productivity of cultivated crops. Relative Humidity

Definition: Relative humidity is defined as the amount of moisture in the atmosphere.

It results in the formation of rain

It affects the performance of crops and animals

High humidity in poultry houses causes mouldiness of feed and litters

Low humidity causes aridity or dryness

It determines the type of crops growing in an area

Low humidity leads to heat-stress in animals e.g. cattle, poultry, oig

It determines the type of crops grown in an area e.g. wheat in the north during harmattan

It affects the growth rate of crops. For instance, cocoa will not grow well under low relative humidity

High relative humidity affects food intake and productivity of farm animals

Relative humidity determines the type of pests prevalent in an area

Relative humidity determines the type of Pests prevalent humidity favours the growth of disease pathogens. **Solar Radiation**

**Definition:** Solar radiation is the amount of heat or sun rays radiated to the

Atmosphere

High intensity of radiation causes heat-stress in animals, and this reduces their growth, production and reproduction

It increases the cost of production because shade has to be provided to protect animals and some crops from direct rays of the sun

Solar radiation assists photosynthesis in crops

Solar radiation assists in drying crops

Solar radiation is a source of farm power

**Biotic factors affecting agricultural production**

## Soil Organisms

These include bacteria, fungi, earthworm, rodent, termite etc

Some, like bacteria and fungi, can cause diseases

Some aid aeration of soil, percolation and fertility

Some, like the root nodule bacteria can fix nutrients directly to plants and soil Some open up wounds on plants or animals for other pathogens to enter Some reduce the quality and quantity of crops e.g. potato, yam etc.

Some help in the decomposition of plants materials to form humus.

## Pests

These include insects, rodents, birds and some mammals

They reduce the yield of crops and animals

They also reduce the quality of crops and animals

Some are vectors or carriers of diseases

They reduce the income of the farmers

The cost of their control increases the cost of production

## Parasites

They include ticks, liver flukes, tapeworms dodder, mistletoe, lice etc.

Some transmit diseases

They reduce the quantity or yield of produce

They also reduce the quality of produce

They may cause the death of plants and animals The reduce production capacity of livestock or crops Cost of control increases cost of production.

They may be external or internal (i.e ecto or endoparasites)

Diseases

They may be diseases caused by viruses, bacteria, fungi , protozoa, e.t.c

They cause reduction in yield of crops and animals

They can cause the loss or death of plants and animals

The cost of control increases the cost of production

They cause reduction in farmer’s income

Weeds

They compete with crops for space, water, nutrients and sunlight.

Some weeds can harbor diseases and pests

They reduce the yield of crops

Weed-control, increases the cost of production

Weeds cause poor growth of crops

Predators

These are birds, rodents, praying mantis etc

Some are beneficial in agricultural production

Some are used to control some harmful pests of crops and animals.

Some feed on farm animals, for example, hawks feed on chicks.

Human activities

Human activities include the influence of man on the production of plants and animals.

1. His activities may improve the fertility of the soil if he uses fertilizers and manure.
2. There could be increase in yield if he practises crop rotation. iii. There could be increase in yield if he controls pests and diseases.
3. Increase in yield or production can also be enhanced if he gets rid of weeds from his farm.
4. Continuous cultivation-bush burning and inability to control erosion can lead to lower agricultural output.

**EDAPHIC FACTORS AFFECTING AGRICULTURAL PRODUCTION**

## 1. SOIL PH

1. It affects the growth of plants
2. It also affects the availability of soil nutrients to plants
3. It affects the presence of soil micro organisms
4. It causes toxicity to plants and animals in the soil.

**SOIL TEXTUREIt determines the type of soil in an area.It determines the level of soil fertilityIt determines the type of crops to be grownIt affects the level of leaching and erosion**

## SOIL STRUCTURE

It determines the fertility of the soil

It determines the water-retaining capacity of the soil

It determines the level of soil organism

It determines the level of soil aeration and percolation.

## TOPOGRAPHY

Topography refers to the shape of the landing relation to the underlying rocks of the earth’s surface

Steep and gentle slopes give rise to soil erosion

Steep and gentle slopes may also aid the weathering of rocks

Even or flat slopes can lead to accumulation of soil

Even or flat slopes can be better sites for intensive farming.

## SOIL FERTILITY

Fertile soil aids the production of food and cash crops

Fertile soil leads to the production of forage crops and plants for grazing.

It minimizes the use of fertilizers and manures

It leads to multiplication of beneficial soil organisms

Fertile soil generally leads to reduction in cost of production.

## SOIL TYPES

Soil types include sand, clay and loamy soil.

Loamy soil is rich in soil nutrients, hence it is the best soil for agriculture.

Sandy soil does not contain enough nutrients, hence it cannot support crop growth.

Sandy soil encourages leaching and prevents soil erosion.

Clay soil encourages water-logging and erosion but prevents leaching of plants nutrients.

Questions:

1. State five climatic factors affecting Agricultural production

1. State 3 major factor affecting agricultural production
2. State five effect of rainfall on Agricultural production
3. State five effect of temperature on Agricultural production

**WEEK 9 & 10**

**PLANTS NUTRIENTS AND NUTRIENT CYCLES**

## MACRO-NUTRIENTS ANDN MICRO-NUTRIENTS

Plants require nutrients or elements obtained from the soil for good growth and healthy development. These elements or nutrients are classified into two main groups which are:

Macro-Nutrients

Macro-nutrients are mineral elements or nutrients required by crops in large quantities. Examples of macro-nutrients are nitrogen, phosphorus, potassium, magnesium, calcium and sulphur.

Micro Nutrients or Trace Elements

Micro nutrients are mineral elements or nutrients required by crops in small quantities. Examples of micro-nutrients are zinc, copper, boron, molybdenum, iron, chlorine and manganese.

## FUNCTIONS AND DEFICIENCY SYMPTOMS OF PLANT NUTRIENTS

The functions and deficiency symptoms of these elements or nutrients are summarized below.

|  |  |  |  |
| --- | --- | --- | --- |
| **S/N** | **ELEMENTS** | **FUNCTIONS** | **DEFICIENCY SYMPTOMS** |
| 1 | Nitrogen | It aids plants growth and reproduction because it is an essential constituent of all proteins.It increases the size of grain in cereals or carbohydrate synthesisIt promotes vegetative and short system growth.Excess nitrogen delays maturation and fruitingIt promotes uptake of potassium and phosphorus from the soilIt promotes chlorophyll formation or deep green colour  of leavesIt is necessary for the synthesis of plant hormones/enzymes/auxins | Stunted growthYellowing of leaves  (chlorosis)Leaves tend to dropPoor formation of fruits and flowers |
| 2 | Phosphorus | It aids enzyme reactionsIt is a constituent of cell nucleus and essential for cell division.It increase crop resistance to diseases.It helps  in ripening of fruitsIt helps in root development, seed germination, fruit formation and maturityIt aids seed germinationIt aids fruit formation and maturityIt improves the palatability of forages and vegetables | Logging results due to poor developments of rootsLeaves turn o  purple or dull greygreen colour.Stunted growthInhibition of flowering, fruits and seed formation |
| 3 | Potassium | It is an important constituent of plant tissuesIt aids synthesis of carbohydrateIt activates various plant enzyme reactionsIt promotes the development of young plantIt is necessary for neutralization of organic acids in plants.It is associated with stomata movement and therefore influences water relationship within the plantIt is a major constituent of plant tissue.It helps in nitrate uptake from the soil | Weak slender stemsDelayed  growthPremature loss of  leavesBrown colour at margin of leaves |
| 4 | Calcium | It strengthens plants cell walls with calcium pectate.It helps in the translocation and storage of carbohydrate and proteins into seed and tubersIt control the toxicity of aluminium manganese and sodium ions.It is necessary for the normal growth of not tipsIt strengthens plant cell wallsIt helps in high flocculation i.e., good aeration, water infiltration and retention.It improves the pH of the soil so that nitrogen fixation can be carried out. | It causes stunting of the root system There is appearance of pale  yellow colour in the leavesWeak slender plants. |

|  |  |  |
| --- | --- | --- |
| 5 Magnesium | It is important in the synthesis of carbohydrate as it is a constituent of chlorophyllIt assists in the transportation of phosphate an essential material to developing fruit seeds.It enhances plant growth.It is necessary for synthesis of oils in plantsIt is required for normal cell division | Chlorosis along the leaf veins Stunted  growthPremature  leaf-fall |
| 6 Sulphur | It is a constituent of plant proteins since it occurs in some amino acids such as cystine and methonine.It is also a constituent of plant hormones such as biotein and thiaminIt is essential for chlorophyll formationIt is also required for carbohydrate metabolism and nitrogen fixation by legumes | Yellowing of leavesStunted growthPoor rate of photosynthesis |
| 7 Iron | It is necessary for chlorophyll formationIt is necessary for protein synthesis contained in chloroplastsIt is important in enzyme systems associated with oxidation and reduction reactions. | Chlorotic condition in leaves, which becomes pale green. |
| 8 Manganese | It is constituent of enzymes which are responsible for protein synthesisIt is important for certain nitrogen transformation in plants and microorganisms | Young leaves shows pale greenish yellow discolouration between veins |
| 9 Copper | It is a constituent of certain enzymes It is necessary for photosynthesisIt is involved in the action of certain enzymes | Pale green colour of leavesThe tips of older leaves dry off and die.Young leaves tips die back. |
| 10 Zinc | It is involved in the action of certain  enzymes | Production of mottled or extremely small leaves |
| 11 Boron | It is an important nutrient in protein synthesisIt facilitates the development of rootsIt assists in the formation of fruits and seedsIt encourages the division of cells in the growing regions of plantsIt increases yieldIt facilitates nodulation in leguminous plants | It causes the death of tips of roots and shoots.Failure of flower buds to developIt causes poor growth of plantsIt causes breaking or lodgingIt decreases the rate of water absorption and  translocation of sugars |

|  |  |  |  |
| --- | --- | --- | --- |
| 12 | Molybinum | It aids nitrogen fixation acids and proteinsIt is an essential part of enzymatic system involved in facilitating nitrogen change. | Promotes metabolism of nitrates into amino acids and proteins.It causes mottled leavesIt leads to curling and breakdown of leaf edgesIt causes premature flower crops. |