Introduction to Agriculture

Definition of Agriculture

- Agriculture is the science and art of cultivation of crops and rearing of livestock.
- **As a science,** it involves ***experimentation*** and ***application of scientific knowledge*** in such areas as;

  Soil analysis,

  Control of pests and diseases,

  Farm machinery and structures,

  Crop and livestock breeding.

- ***As an art, it involves the use of learned skills in;***

  Tilling the land,

  Construction,

  Measurement,

  Harvesting of crops,

  Feeding and handling of livestock

  Marketing.

Branches of Agriculture

Crop Farming (Arable Farming)

- The practice of growing crops on cultivated land.

It is subdivided into:

- ***Field crops Cultivation***:

  maize, beans, potatoes, coffee, tea, cotton to name but a few.

- ***Horticulture:***

  It involves the growing of perishable crops which have high value.

  It is further subdivided into:

  Floriculture - the growing of flowers.

  Olericulture - the growing of vegetables.

Pomoculture - the growing of fruits.

Livestock Farming

- This branch deals with the rearing of livestock for various products.

It is further subdivided into:

- ***Pastoralism:*** This is the rearing of mammalian livestock such as cattle, sheep, goats, rabbits, pigs and camels.
- ***Fish Farming (Aquaculture):*** This is the practice of rearing fish and other aquatic organisms , in ponds.
- ***Bee Keeping (Apiculture):*** This involves the rearing of bees in structures known as beehives.
- ***Poultry Keeping****:* This is the keeping of domesticated birds.

Agricultural Economics

- It deals with the allocation of scarce resources (land, labour, capital and management) for agricultural production.

Agricultural Engineering

- This branch of agriculture deals with the use and maintenance of farm tools, machinery and structures.

Farming Systems

- A farming system is the organization of the various enterprises in a farm.

It is determined by the following factors:

- Resources available (land, labour, capital and management).
- Skills of the farmer.
- Environmental factors such as climate, soil type and topography.
- Government policy.
- Farmer's choice and preference.
- Enterprise requirement.
- Social-cultural factors.

The following are systems of farming:

Extensive System:

- It is a system where a large piece of land with low investment of resources per unit area is carried out.

Advantages

- It is cheap.
- Does not require high level of management.
- Requires less labour.

Disadvantages

- Low profit per unit area.
- Cannot be practiced where land is limited.
- Low output per unit area.
- The land is under-utilized,

Intensive Farming:

- This system utilizes the factors of production to the maximum and involves high level of management.

Advantages

- Maximum utilization of the resources.
- Can be practiced even where land is a limiting factor.
- Results in high yields.

Disadvantages

- Labour intensive.
- High capital investment is required.
- Requires high level of management.
- Can lead to high loses in case of poor management.

Large Scale Farming

- Refers to the farming practice under large areas of land over 20 hectares.
- It is used mainly for commercial purposes.
- The system is highly mechanized.

Advantages

- Results in high yields.
- Due to economics of scale high profit is realized.

Disadvantages

- Lack of diversification may lead to total failure in case of unfavorable conditions.

- High level of management is required.
- Heavy capital investment.
- Requires skilled and qualified manpower.

Small Scale Farming

- Refers to farming carried out on a small area of land less than 5 hectares.
- Family or casual labour can be engaged during the peak periods.
- Most of the Kenyan farmers are small scale due to unavailability of farmland.

Advantages

- Requires low capital investment.
- Possible where land is a limiting factor.
- Does not require high management level unless under intensive system.

Disadvantages

- Uneconomical 10 mechanize due to small size.
- Low production.
- Provides limited employment.
- Labour intensive.
- Difficult to specialize.

Methods of Farming

- A method of farming is an established way of carrying out farming activities.
- The following are the common methods of farming:

Mixed Farming

- It is the practice of growing crops and keeping of livestock on the same land.
- Its common in high potential areas.

Advantages

- Mutual benefit between crops and livestock.
- Crops supply feed for animals while animals supply manure for crops.
- Acts as an insurance against total loss by the farmer.
- The farmer is assured of an income throughout the year.
- There is maximum utilization of the resources.
- Animals can be used in the farm activities particularly draught animals.
- Ensures proper utilization of labour and land throughout the year.

Disadvantages

- High initial capital.
- Lack of specialization.
- Land can be a limiting factor if both enterprises are to be raised.

- Requires high level of management for both enterprises.

Nomadic-Pastoralism

- This is the practice of livestock rearing whereby animals are moved from one place to another in search of water and pastures.
- It is practiced in the arid and semi-arid areas where in most cases beef animals are kept.

Nomadic pastoralism is gradually changing to ranching with the introduction of:

- Improved pasture species, improved livestock breeds and supplementary feeding.
- Efficient disease and parasite control measures.
- Improved infra-structure such as roads, water supply, cattle dipping facilities.
- Extension services.

Advantages

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

Disadvantages

- It encourages the spread of livestock pests and diseases due to communal watering points, grazing and dipping facilities.
- There is a tendency to increased soil erosion and land degradation.
- Source of conflicts and ethnic tension among the nomadic communities for the control of good pastures and water.
- Difficult to control breeding and breeding diseases.
- High rate of inbreeding leading to poor quality livestock.
- Low production of milk, meat, hides and skins due to wastage of energy in traveling from one place to another in search of pastures and water.
- High death rates as a result of walking for long distances.

Shifting Cultivation

- It is a traditional method of cultivating a piece of land until the soil is exhausted and crop yields decline.
- The land is abandoned and the farmer shifts to a new field as the previous land is left fallow to regain its fertility.

Advantages

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

Disadvantages

- Not practical where land is a limiting factor.
- Farm planning and acquisition of credits for land development is 'not possible.
- It is a cumbersome method due to constant movement.
- Lack of soil conservation measures
- Not possible to grow perennial crops.
- Low output per unit area due to poor farming methods.
- Where fire is used to clear the land organic matter is destroyed.

Organic Farming

- It is a fanning method where crops are grown and livestock reared without the use of agrochemicals.
- It is a method of farming which has been adopted to reduce the long term effect of the agro-chemicals on crops which may eventually end up in man and livestock.
- Agro-chemicals are also expensive thus organic farming reduces the cost of production. Organically produced goods fetch high market prices.

Advantages

- Cheap and cost effective.
- Make use of the locally available materials
- Useful in improving the soil structures.
- No side effects from the crops and livestock products.
- No environmental pollution.

Agro-Forestry

- This is the practice of integrating trees and crops on the same piece of land.
- With land resources becoming more scarce, agroforestry is becoming more important.

Examples of common agroforestry trees and shrubs include:

- ***Cajanus cajan***
- ***Grevillea robusta***
- ***Sesbania sesban***
- ***Calliandra calothyrsus***
- ***Casuarina equisetifolia***
- ***Leucaena leucocephala***

Trees selected for agroforestry should have the following characteristics:

- Able to grow fast.
- Deep roots to minimize competition for nutrients.
- Should be preferably leguminous.

Advantages

- Trees reduce soil erosion in a given area.
- Leguminous trees add nitrates into the soil thus improving the *soil* fertility.
- Some trees can be used as livestock fodder to provide a high level of proteins.
- They are important sources of wood fuel and timber.
- There is maximum utilization of land.

Importance of Agriculture to the Economy of Kenya

- Provides ***food*** to the population to meet nutritional requirements and to enable man to engage in other activities of farming.
- Provides ***employment***. This for example can be direct as a labourer in the farm, tea plucker or indirect for example, working in agricultural based industries.
- Source of ***raw materials*** for industries for example cotton lint for textile industry.
- Provides ***foreign exchange*** - through exporting agricultural produce.
- Provides ***market for industrial goods*** agriculture is a consumer of the finished goods from agro-based industries.
- Source of ***income*** - farmers as well as the government get revenue from the sale of agricultural produce and tax payment.

Factors Influencing Agriculture

Introduction

Agricultural production is influenced by external factors:

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

Human Factors

These are human characteristics which affect the way decisions are made and operations carried out.

- ***Level of education and technology***:

  Skills

Technological ad van cements .

- ***Human health/HIV-AIDS***:

These affect the strength, the vigour, vision and the determination to work.

HIV/AIDS is the biggest threat to human health today and has long lasting effects on agriculture, such as;

Shortage of farm labour.

Loss of family support.

Low living standards leading to despondency and hopelessness.

Increased criminal activities.

More time spent by the Government and NGO's in Carring for the sick.

- ***Economy;***

Stability in the countries' economy affect agricultural production.

- **Government Policy:**

These are governmental laws which have been enacted to protect farmers, land and livestock.

They include:

Food policy

Policies on control of livestock parasites and diseases.

Policies on marketing of both local and export products and others.

- ***Transport and communication***:

For agricultural goods to move from the farm to the consumers.

- ***Cultural practices and religious beliefs:***

These activities hinder important changes in a society that may bring agricultural development.

- ***Market forces:***

Demand and supply forces which affect prices of commodities in a free market.

Biotic Factors

These are living organisms which affect agricultural production.

- ***Pests -*** Destructive organisms which destroy crops.
- ***Parasites*** - These are invertebrates which live in or on other living organisms.
- ***Decomposers -*** Organisms which act on plants and animal tissues to form manure.
- ***Pathogens*** - Micro-organisms which cause diseases.
- ***Predators*** - Animals that kill and feed on other animals.
- ***Pollinators*** - They transfer pollen grains from the stamens to the pistil of a flower.

- ***Nitrogen fixing bacteria*** -They are micro-organisms which convert atmospheric nitrogen to nitrates ready for use by the plants.

Climatic Factors(weather elements).

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

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

Climate - weather conditions of a place observed and recorded for a period of 30-40 years.

Rainfall

Supplies Water:

- Which is necessary for the life process in plants and animals.
- Which makes the plant turgid hence provides support.
- Acts as a solvent for plant nutrients.
- Cools the plant during transpiration.
- Which is used as a raw material in photosynthesis.

When plants lack enough water they respond in different ways as follows:

- By closing the stomata to restrict water loss.
- Hastens maturity.
- Some will roll their leaves.

Other plants have developed permanent adaptation to water stress such as:

- Growing needle like leaves.
- Develop fleshy leaves for water storage.
- Develop long roots.
- Wilting and death in extreme conditions.

Important Aspects of Rainfall:

- ***Rainfall reliability***;

  This is the dependency on the timing of the onset of the rains.
- ***Amount of rainfall***;

  Quantity of rain that falls in a given area within a given year.
- ***Rainfall distribution*** ;

  The number of wet months in a year.
- ***Rainfall intensity***;

  Amount of rainfall that falls in an area within a period of 1 hour.

Temperature

- This is the degree of hotness or coldness of a place measured in degrees Celsius.
- ***Cardinal range*** of temperature is the temperature required by plant to grow and thrive well.
- ***Optimum range of temperatures*** - the best temperature for the best performance of plants.

Effects of Temperatures on Crop Production:

Low temperatures:

- Slow the growth rate of crops due to slowed photosynthesis and respiration.
- High incidences of disease infection.
- Improves quality of crops such as tea and pyrethrum.

High Temperatures

- Increase evaporation rate leading to
- Wilting.
- Hastens the maturity of crops.
- Increase disease and pest infection.
- Improves quality of crops such as pineapples, oranges and pawpaws.

Wind

Wind is moving air.

Good effects of wind include:

- Seed dispersal
- Cooling of land
- Pollination in crops
- Brings rain bearing clouds

Negative effects of wind:

- Increases the rate of evaporation of water.
- Causes lodging of cereals and distorts perennial crops.
- Increases evapo-transpiration.
- Spreads diseases and pests.
- Destroys farm structures.

Relative humidity

- The amount of water vapour in the air
- Affects the rate of evapo-transpiration.
- Forms dew which supplies soil with moisture under dry conditions.
- High humidity induce rooting in cuttings.
- Increases disease multiplication and spread.

Light

- Provide radiant energy harnessed by green plant for photosynthesis.

Important aspects of light:

- ***Light intensity*** ;
  The strength with which light is harnessed by chlorophyll for photosynthesis.
- ***Light duration***;
  The period during which light is available to plants per day.
  Plant response to light duration is known as ***photoperiodism.***

  Short-day plants - require less than 12 hours of daylight to flower and seed.

  Long-day plants - require more than 12 hours of daylight to flower and seed.

  Day-neutral plants require 12 hours of daylight to flower and seed.
- ***Light wavelength;***
  This is the distance between two - successive crests of a wavelength.
  It dictates the difference between natural and artificial light.
  Chlorophyll absorbs certain wavelengths of light.

Edaphic Factors Influencing Agriculture

- These are soil factors.
- Soil is the natural material that covers the surface of the earth,
- Made of weathered rock particles and decomposed animal and plant tissues, and on which plants grow.

Importance of Soil

- Provides anchorage to the plants by holding their roots firmly.
- Provides plants with mineral salts/ nutrients which are necessary for their growth.
- Provide the plants with water.
- Contains oxygen necessary for respiration of the plants and soil micro-organisms.

Soil Formation:

- Soil is formed through weathering process.
- Weathering is the breakdown and alteration of the parent rock near the surface of the earth to a stable substance.
- Weathering process is a combination of disintegration (breakdown) and synthesis (build up) process.
- Weathering process is continuous.

Types of Weathering

- Physical weathering
- Chemical weathering
- Biological weathering

Agents of Weathering

Physical Agents of Weathering

- Include wind, water, moving ice and temperature.
- ***Wind -*** carry materials which hit against each other to break into fragments.
- ***Water*** - intensity of rainfall causes breakdown of rock.
- ***Moving ice*** - has grinding effects which tear off rock particles.
- ***Extreme temperature*** cause rocks to expand and contract suddenly peeling off their surface.

Chemical Weathering

- Affects the chemical composition and structure of the rock.
- Involves processes such as ;
  - Hydrolysis,
  - Hydration,
  - Carbonation
  - Oxidation.
- ***Hydration;***

  The process by which soluble minerals in the rocks absorb water and expand weakening the rock thus leading to disintegration.

- ***Hydrolysis;***
  The process whereby water dissolves soluble minerals in the rock weakening it.
- ***Oxidation****;*
  *T*he reaction of rock minerals with oxygen to form oxides which break easily.
- ***Carbonation****;*
  *T*he process whereby carbonic acids formed when rain water dissolves carbon dioxide,
  It reacts with calcium carbonates in limestone causing it to disintegrate.

Biological Weathering

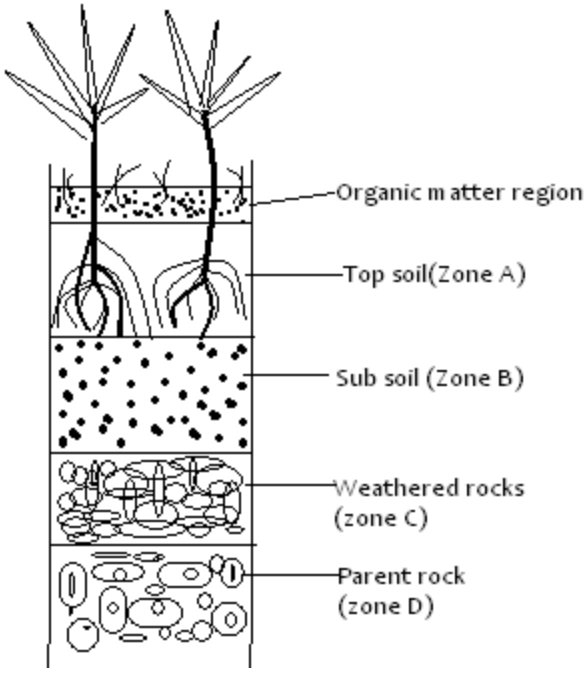
This involves the action of living organisms, plants and animals on the rocks.

- ***Burrowing animals***, for example, termites and moles bring soil particles to the surface exposing them to other agents of weathering.
- ***Big animals*** like, elephants, buffaloes, camels and cattle exert a lot of pressure on the rocks as they step on them due to their heavy weights causing the rocks to disintegrate.
- ***Earthworms*** take part in the decomposition of plant matter with the soil particles.
- ***Man's activities*** like, mining and quarrying expose rocks to the surface during excavation. These activities breakdown large rocks into smaller rock particles.
- ***Plant roots*** force their way through the cracks in the rocks thus widening and splitting them.
- ***Humic acids*** formed when plant tissues decompose react with the rocks weakening them further.
- ***Plant remains***-decompose adding humus into the soil.

Factors influencing soil formation

- ***Climate-*** (rainfall, temperature and wind)
- ***Biotic factors*** - living organisms.
- ***Parent material***- Nature and properties of the original rock from which the soil is formed.
- **Time -** length of time during which the soil forming processes have taken place.
- ***Topography*** - influences the movement of disintegrated materials.

Soil Profile



- It is the vertical arrangement of different layers of soil from the ground surface to the bedrock.
- These layers are also referred to as ***horizons.***
- The layers show differences in their contents and physical properties such as colour, texture and structure.

- The layers include: organic matter region, top soil, sub-soil, weathered rocks and parent material.

Organic Matter Region

- First layer of the soil found on the surface.
- Made up of leaves and other plant remains at various stages of decomposition.
- Some soil organisms may also be found here.

Top Soil

- Has a dark colour due to the presence of humus.
- Is rich in plant nutrients and well aerated.
- It is a zone of maximum leaching (zone of eluviations)

Sub-Soil

- It is compact and less aerated.

- It is a zone of accumulation of leached material (zone of aluviation) from the top layers.
- Deep rooted crops have their roots growing up to this region.
- Hard pans normally form in this layer

Weathered Rocks

- It is also called substratum.
- Rocks at various stages of disintegration are found in this zone.
- Most of the materials found in this zone originate from the parent rock.

Parent Rock

- It exists as a solid mass which is un-weathered.
- It is the source of the inorganic composition of the soil.
- The water table is on the surface of this rock.

Soils Formed in Situ and Soils Deposited

- Soil formed in the same place and remains there is said to be ***in situ.***
- However, soil can be formed due to deposition of soil particles carried from its original site of formation to another area which is usually in the lower areas of slopes.
- Such soils are said to have been formed through deposition.

Soil Formed in Situ	***Soil Deposited***
l.Has the colour of the parent rock	1. Has the characteristics of when: it came from.
2. Shallower	2. Deeper
3. Less rich in plant nutrients	3. Richer in plant nutrients
4. Easily eroded	4. Not easily eroded
5. Less silty	5. More silty
6. Have the same chemical composition as that of the underlying parent rock.	6. Differ in chemical composition from the underlying parent rock.

Soil Depth

- This is the distance between top soil layer and the bottom soil layer in a profile.
- It dictates root penetration and growth
- Deep soils are more suitable for crop growth since they contain more nutrients.
- Have a larger surface are for root expansion.

- Deep soils facilitate good drainage and aeration.

Soil Constituents

- ***Organic Matter*** - Dead and decaying plants and animal remains
- ***Living Organisms*** - Soil organisms and plant roots.

  Micro-organisms (bacteria, protozoa and fungi)
  Invertebrates -termites,
  Earthworms and molluscs.
  Higher animals - rodents and others.
- ***Inorganic or Mineral Matter***

  Formed from the parent materials.
  Supply plant nutrients
  Form the skeleton and framework of the soil.
- ***Air***

  Found in the pore spaces of the soil.
  Used for root and organism respiration
  Used for germination of seeds.
  Helps in decomposition of organic matter.
  Regulates soil temperature.
  Regulates the movement of water through capillary action.

- ***Water***

  Dissolves mineral salts
  Maintain turgidity in plants.
  Used for germination of seeds
  Used by soil organisms.
  Regulate soil temperature
  Dictates the amount of air in the soil.

Water in the soil exists in three forms namely:

- ***Superfluous/Gravitational Water***

  Found in the large spaces (macro-pores) in the soil particles.
  Held by gravitation forces.
  When the pores are saturated, the soil is said to be waterlogged.
  It moves and may cause leaching.

- ***Hygroscopic Water***

  Water found in thin films on the soil particles.
  Held by strong adhesive forces between water and soil particles.

Does not move and hence not available for plant use.

- ***Capillary Water***

  Occupy micro-pores in the soil particles.

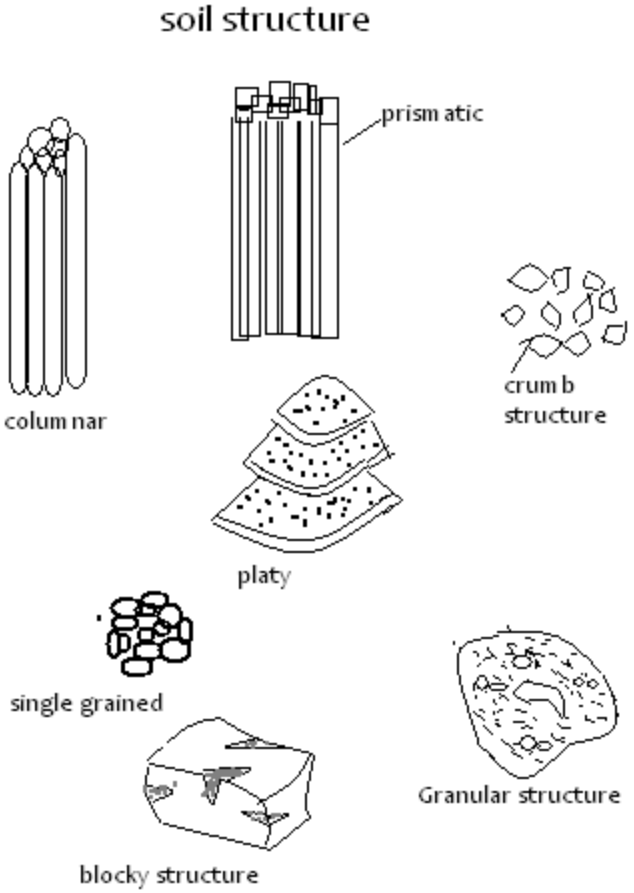
  Held by cohesive forces between water molecules.
  Moves through capillary action
  Available to plants for use.

Soil Structure

- This is the arrangement of soil particles in a soil horizon.
- ***Types of Soil Structure –***

  Single-grained

  Crumby
  Granular
  Prismatic
  Columnar
  Platy
  Blocky



Importance of Soil Structure on Crop Production

Soil Structure Influences

- Soil aeration
- Soil drainage and water holding capacity.
- Plants root penetrability and anchorage.
- Microbial activities in the soil.
- Circulation of gases in the soil.

Farming practices which improve the soil structure are:

- Application of inorganic manure into the soil.
- Tilling the land at the right moisture content.
- Crop rotation.
- Minimum tillage.
- Cover cropping.
- Mulching.

Soil Texture

- It refers to the relative proportion of the various sizes of the mineral particles of soil.

Importance of Soil Texture on Crop Production;

- Influences soil fertility
- Affects the organic matter content
- Influences the drainage of the soil.
- Influences soil aeration.
- Influences water holding capacity.
- Influences the capillarity or movement of water in the soil.

Soil Textural Classes

Sandy Soils

- Made up largely of sand particles.
- Have large pore spaces hence poor in water retention.
- Easy to till (light soils).
- Freely draining.
- Low fertility due to leaching of minerals.
- Easily erodible.

Clayey Soils

- Made up largely of clayey particles.
- Have small pore spaces hence good in moisture retention.
- Difficult to till (heavy soils).

- Poorly 'drained.
- Expand when wet, crack when dry.
- High capillary.
- Rich in plant nutrients.

Loam Soils

- About equal amounts of sand and clay.
- Moderately good in both moisture and air retention.
- Fertile soils.

Soil Colour

- This depends on the, mineral composition of the parent rock and the organic matter content.
- Soils containing a lot of iron are brownish, yellowing and reddish in colour.
- Soils with a lot of silica are white.
- Soils with a lot of humus are dark or grey.

Soil pH

- This refers to the acidity or alkalinity of the soil solution/the concentration of hydrogen ions in the soil solution.
- Soil pH is determined by the concentration of hydrogen ions (H+) or the hydroxyl ions (OH) in the soil solution.
- A pH of less than 7 means that the soil is acidic.
- A pH of more than 7 means that the soil is alkaline.
- As the hydroxyl ions (OH) in the soil increase the soil becomes more alkaline.

Influence of Soil pH Crop Growth

- It determines the type of crop to be grown in a particular area.
- Most crops are affected by either very acidic or very basic soil pH.
- Soil pH affects the choice of fertilizers and the availability of nutrients to crops.
- At low pH the concentration of available iron and aluminium in the soil solution may increase to toxic levels, which is harmful to plants.
- Very acidic or low pH inhibit the activity of soil micro-organisms.

Farm Tools and Equipment

Introduction

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

Garden Tools and Equipment

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

23. Meter ruler	Measuring distances.
24. Garden fork	Shallow digging.

Livestock Production Tools and Equipment

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

Teeth clipper	Removal of canine teeth of piglets soon after birth.
Chaff cutter	Cutting fodder into small bits.
Dehorning wire	Cutting grown horns.

Workshop Tools and Equipment

Tools	Uses
Spanner	Tightening and loosening nuts and bolts.
Pliers	Cutting small wires and thin metal and gripping firmly.
Files	Sharpening tools, smoothening or shaping edges of metals,
Rasps	Smoothening and shaping of wooden structures.
Chisels (wood)	Making grooves in wood.
Cold chisel	Cutting and shaping metal.
Screw drivers Saws Cross cut saw Rip saw Hack saw Bow saw Tenonlback saw Coping saw Compass/keyhole saw Tin snip	Driving screws in or out of wood or metal. Cutting across the grain of wood. Cutting along the grain of wood. Cutting metals. Cutting branches of trees. Cutting Joints on wood and fine sawing. Cutting curves on thin wood. Cutting either along or across the grain of wood especially when cutting key holes. Cutting metal sheets.
Braces and bits.	Boring holes in wood.

Drill and bits	Boring holes in metal work and woodwork.
Hammer	
Claw hammer	Driving in, removing and straightening nails.
Ball pein	Driving in nails, rivets and straightening metal. Also used on cold chisel
Mallet	Hammering or hitting wood chisel.
Jack plane	Fine finishing of wood.
Scrappers/spokeshave	Smoothening curved surfaces of wood such as handles of
Measuring equipment	jembes, axes.
Metre ruler Try square	Measuring short length -. Measuring length angles and to ascertain squareness.
Marking gauge	Marking parallel lines to the edge of wood.
Fencing pliers	Cutting wires, hammering staples when fencing.
Vice and clamps	Firmly holding pieces of work together.

Tools	Uses
Spirit level	Measuring horizontal or vertical levels.
Soldering gun	Melting soldering rods when repairing or fabricating metal sheets.
Wire brush	Brushing rough surfaces.
Divider	Marking and laying out.

Centre punch	Marking the point of drilling.
Paint brush	Applying paint on surfaces.
Sledge hammer	Ramming hardware, breaking stones.
Wire strainer	Tightening wires during fencing.
Riveting machine	Fix rivets when joining pieces of metal.
Claw bar	Removing long nails from wood, straining fencing wires and digging fencing holes.

Plumbing and Masonry Tools

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

Care and Maintenance of Tools and Equipment

Reasons for Maintenance

- To increase durability.
- To increase efficiency.
- Reduce costs of replacement.

- For safety of the user/avoid accidents.
- Avoid damage to the tool.

Methods

- Use tools for the right work.
- Proper handling when using tools or equipment.
- Clean and oil tools after work.
- Keep tools in there right place.
- Replace and repair worn-out parts
- Sharpen cutting or digging edges
- Grease moving parts to reduce friction
- Use safety devices in the workshop to reduce accidents and breakages

CROP PRODUCTION 1

(Land Preparation)

Introduction

- A piece of land which is prepared is known as seedbed.
- A seedbed is a piece of land that is prepared ready to receive planting materials.

Seedbed Preparation

Reasons for Seedbed Preparation;

- To enable water to infiltrate.
- To kill weeds
- To improve soil aeration.
- To destroy pests and diseases.
- To incorporate organic matter in the soil.
- For easy planting.
- To facilitate root penetration.

Operations in Land Preparation

Land Clearing

- Clearing of land is necessary when:

- Opening up a virgin land.
- A stalk growing crop was previously planted.
- There is long interval between primary and secondary cultivation.
- Land was left fallow for a long time.

Procedure

- Tree felling and removal of stumps and roots.
- Burning
- Slashing
- Use of chemicals.

Note: **Burning** should be avoided where possible since it;

- Leads to loss of organic matter,
- Kills soil organisms
- Destroys soil structure and plant nutrients.

Primary Cultivation

- This is the initial breaking of land.
- It is done early before the onset of the rains to:
  - Give time for soil organisms to act on organic matter.
  - Allow gaseous exchange to take place, thus carbon dioxide diffuses out of the soil while oxygen enters into the soil.
  - Allow other operations to take place in time.

Reasons for primary cultivation:

- Remove weeds.
- Burry organic matter.
- Open up soil for infiltration of water and air.
- Expose pests and disease causing organisms.
- Soften the soil for easy planting.

Operations in primary cultivation

- ***Hand digging*** ;

  Use of hand tools ;

  - Jembes,
  - Mattocks,
  - Fork-jembes.

- ***Mechanical cultivation*** ;

  Use of mouldboard ploughs;

  - Disc ploughs,

Chisel ploughs,
Subsoilers
Rippers.

- ***Use of Ox-Ploughs*** ;

Which can be drawn by;

Oxen,
Donkeys,
Camels

Depth of Cultivation

Depends on:

- The type of crop to be planted/size of seed.
- The implements available.
- The type of soil.

Choice of Implement

Determined by:

- The condition of land.
- The type of tilth required/type of crop.
- Depth of cultivation.

Secondary Tillage

- These are refinement practices on the seedbed that follow primary cultivation.
- It is also known as harrowing.

Reasons for secondary Tillage:

- To remove the germinating weeds.
- To break soil clods to produce required tilth.
- To level the seedbed for uniform planting.
- To incorporate organic matter/manure into the soil.

Factors determining number of secondary cultivation:

- Soil moisture content.
- Size of the planting materials.
- Condition of the soil after primary cultivation.
- Slope of the land.

Tertiary Operations:

- ***Ridging ;***

  The process of digging soil on a continuous line and heaping on one side to produce a furrow and a bund (ridge).

  It is important for root crops, to allow root expansion and for soil and water conservation.

- ***Rolling:***

  It is the compaction of the soil to produce a firm surface which increases seed-soil contact and prevents wind erosion.

- ***Levelling;***

  Production of an even, uniform surface which promotes uniform planting.

Subsoiling:

- This is deep cultivation into the subsoil layer to break up any hardpan which might have developed.

It is done for the following reasons:-

- To facilitate drainage.
- Bring up leached nutrients to the surface.
- Increase aeration of the soil.
- To improve root penetration.
- The implements used include ***chisel plough*** and ***subsoilers.***

Minimum Tillage:

- This is the application of a combination of farming practices with the aim of reducing the disturbance of the soil.

Examples of which include:

- Use of herbicides.
- Mulching and cover-cropping.
- Timely operations to prevent weed infestation.
- Strip cultivation.
- Uprooting and slashing of weeds.

Reasons for Minimum Tillage

- To reduce cost of cultivation.
- To control soil erosion.

- To preserve soil moisture.
- To prevent root exposure and damage.
- To reconstruct destroyed soil structure.

Water Supply, Irrigation and Drainage

Introduction

- Water is a very important natural resource.
- It is necessary for both crops and livestock.

Uses of water in the farm;

- Cleaning equipment.
- Irrigation in dry areas.
- Processing farm produce, for example, coffee.
- Drinking by livestock and man.
- Mixing agro-chemicals such as acaricide, fungicides and herbicides.
- Providing power in water mills to grind grain crops.
- Cooling engines.
- Construction work.

Sources of Water in the Farm

Three major sources of water in the farm:

- ***Surface water***:

Includes water from;

Rivers,
Streams
Dams.

- ***Ground water***:

Includes water from;

Springs,
Wells
Boreholes.

- ***Rain water:***

This is water tapped in various ways such as;

Rooftops
Rock surface, when it is raining and stored in various ways.

Collection and Storage of Water

- **Dams:**

These are structures constructed across rivers and channels.
They collect and store water for use during the dry season.

- ***Weirs:***

  These are structures constructed across rivers to raise the water level for easy pumping.
  Unlike in the dams water flows over the barrier created across the river.

- ***Water Tanks:***

  These are structures made of concrete, stone, metal sheets and plastics.
  They store water from rain or that which has been pumped from other sources.
  Tanks should be covered to prevent contamination from dust.

Pumps and Pumping of Water

- Pumping is the lifting of water from one point to another by use of mechanical force.
- Water is pumped from the various sources and then conveyed to where it is required for use or storage.

Types of Water Pumps

Used to lift water from its source.

- Centrifugal pumps
- Piston or reciprocating pumps
- Semi-rotary pumps and
- Hydram

Conveyance of Water

- This is the process of moving water from one point, usually the source or point of storage to where it will be used or stored.
- ***Piping***;

  This is where water is moved through pipes.

  The common types of pipes include:

  Metal pipes

  Plastic pipes

  Hose pipes

- ***Use of Containers****:*

  In this case water is drawn and put in containers .
  drums, jerry cans, pots, gourds, tanks and buckets .
  Which are carried by animals, bicycles, human beings and vehicles.

- ***Use of Canals:***

  In this case water is conveyed from a high point to a lower one along a gradual slope to avoid soil erosion.
  Water conveyed through this way is mostly used for irrigation and livestock.

Water Treatment

- Raw water contains impurities which may be dissolved, floating or suspended in water.

These impurities are grouped into three categories, namely:

- ***Physical impurities***: these are dissolved impurities detected by colour, taste and smell.
- ***Chemical impurities:*** these are dissolved impurities detected by use of chemical analysis.
- ***Biological impurities:*** these are microorganisms in water such as bacteria, viruses and algae.

Importance of Treating Water

- To kill disease causing microorganisms such as cholera and typhoid bacteria that thrive in dirty water.
- To remove chemical impurities such as excess fluoride which may be harmful to human beings.
- To remove smells and bad taste.
- To remove sediments of solid particles such as soil, sand and sticks.

Methods of Treating Water

- ***Aeration:*** this is the removal of smell and odour from water by fine spraying or bubbling of air.
- ***Sedimentation:*** this is where water is put in large containers so that solid particles such as sand, metal and others can settle at the bottom.
- ***Filtration:*** this is passing water through fine granular materials to remove solid particles and biological substances.
- ***Coagulation:*** addition of chemicals which precipitate impurities and help in softening of hard water.
- ***Chlorination:*** Sterilization to destroy disease causing organisms.

Irrigation

- It is the artificial application of water to crops in dry areas or where water is not enough.
- It is one of the methods of land reclamation in case of arid and semi arid areas.

Factors to Consider in Identifying and Assessing the Potential of Land for Irrigation Development

- Topography of the land
- Soil type
- Type of crop to be grown
- Water availability
- Human factors such as skill, capital availability and economic activities.

Types of Irrigation

- ***Surface irrigation***:

  This includes flood irrigation and basin irrigation.

  It is used in flat areas.

  The problem with this method is loss of water through seepage.

  It also increases soil salinity.

- ***Sub-surface Irrigation:***

  This involves the use of porous pipes or perforated pipes.
  It is used in slopy areas and where water is inadequate.

- ***Overhead or Sprinkler Irrigation*:**

  It is used in any area which is not steep.

- ***Drip or Trickle Irrigation:***

  It is used where water is little and in relatively sloppy and flat areas.

Drainage

- This is a method of removing excess water or lowering the water table from a marshy water-logged land.
- It is also a method of land reclamation.

Importance of Drainage as a Method of Land Reclamation

- To increase soil aeration.
- To raise soil temperature.
- To increase microbial activities in the soil.
- To reduce toxic substances from the soil.
- To increase soil volume for exploitation by plant roots.

Methods of Drainage

- Use of open ditches.
- Use of underground drain pipes.

- French drains.
- Cambered beds.
- Pumping out water from the soil.
- Planting tree species which absorb a lot of water for example eucalyptus.

Water Pollution

- This is the process by which harmful substances get into the water.
- The harmful substance is referred to as a **pollutant.**

Agricultural practices which pollute water include:

- Use of inorganic fertilizers.
- Use of pesticides.
- Poor cultivation practices such as over cultivation, cultivating along the river banks.
- Overgrazing which leads to erosion of soil thus causing siltation in water sources.

Methods of Preventing Water Pollution

- Soil conservation measures which minimize soil losses through erosion.
- Fencing off the water sources.
- Adopting organic farming practices for example controlling pests and weed using non-chemical techniques.
- Planting grass along river banks to minimize siltation in rivers.
- Proper disposal of empty chemical containers.

Soil Fertility I

(Organic Manures)

Introduction

- Soil fertility is the ability of the soil to provide crops with the required nutrients in their proper proportions.

Characteristics of a Fertile Soil

- ***Good depth*** - Good soils give roots greater volume to obtain plant nutrients and provide strong anchorage.

- ***Good aeration*** - for the respiration of plant roots and use by soil organisms.
- ***Good water holding capacity*** - ensures provision of adequate water for plant growth.
- ***Proper drainage*** - ensures provision of adequate air for plant growth.
- ***Correct soil pH*** - different crops have different soil pH requirements.
- ***Adequate nutrients supply*** - it should supply the required nutrients in the correct amounts and in a form available to plants.
- ***Free from excessive*** infestation of soil borne pests and diseases.

How soil loses fertility

- ***Leaching:*** vertical movement of dissolved minerals from the top to the lower horizons of the soil profile.
- ***Soil erosion*** - The removal and carrying away of the top fertile soil from one place to another.
- ***Monocropping*** - This is the practice of growing one type of crop on a piece' of a land over a long time.
- ***Continuous cropping -*** crops take away a lot of nutrients from the soil which are never returned.
- ***Growing crops continuously*** without giving the soil time to rest makes the soil infertile.
- ***Change in soil pH*** - changes in soil pH affect the activity of soil microorganisms as well as the availability of soil nutrients.
- ***Burning of vegetation*** - burning of vegetation cover destroys organic matter. It also exposes the soil to the agents of soil erosion.
- ***Accumulation of salts*** - soils with a lot of salts are said to be saline. State of having too much salt in the soil is referred to as soil salinity.
- Salts accumulation cause water deficiency in plants. It may also lead to change in soil pH.

Maintenance of Soil Fertility

Soil fertility is maintained through the following methods:

- ***Control of Soil Erosion ;***

  Terracing,

  Contour cultivation,

  Strip cropping,

Cut off drains

Planting cover crops.

- ***Crop Rotation ;***

  Practice of growing different crops on the same field in different seasons in an orderly sequence.

- ***Control of Soil pH*** :

  Application of liming materials such as ***limestone, quicklime, magnesium carbonate and slaked lime if the soil is acidic.***

  Application of acidic fertilizers if the soil is alkaline.
  Application of manures.

- ***Proper drainage;***

  Done through:

  Breaking hard pan.
  Construction of water channels.
  Growing crops on cambered bed
  Pumping out water from the soil.

- ***Weed control:***

  Use of herbicides.
  Slashing
  Uprooting.
  Mulching
  Use of proper farming practices such as early planting, correct spacing and cover crops.

- ***Intercropping*** –

  Farming practice where different crops species are grown together in the field.

- ***Minimum Tillage;***

  Use of herbicides.
  Uprooting of weeds.
  Slashing weeds
  Mulching
  Strip cultivation.

- ***Use of Inorganic Fertilizer*** ;

  Chemical compounds manufactured to apply specific plant nutrients for example calcium ammonium nitrate (CAN).

- ***Use of Manure;***

  Well decomposed manures release nutrients into the soil and increase its water holding capacity.

Organic Manures

- Manures are derived from plants and animal remains.
- They supply organic matter to the soil which after decomposition releases plant nutrients.
- The end product of this decomposition is known as humus.
- It influences soil chemical properties and soil temperature.
- Manures supply a wide range of essential plant nutrients.

Importance of Organic Matter in the Soil

- Increases the soil water holding capacity of the soil.
- Improves soil fertility by releasing a wide range of nutrients into the soil.
- Provides food and shelter for soil micro-organisms.
- Improves the soil structure.
- Buffers soil pH/moderates soil pH.
- Reduces the toxicity of plant poisons in the soil.
- Moderates soil temperature by its dark colour.

Limitations in the Use of Manure

- They are bulky - low nutritive value per unit volume.
- Laborious in application and transport.
- They spread diseases, pests and weeds.
- Loss of nutrients if poorly stored.
- If not fully decomposed crops may not benefit from them.

Types of Organic Manures

- Green manure.
- Farm yard manure.
- Compost manure

Green Manure

- Made from green plants which are grown for the purpose of incorporating into the soil.

Characteristics of plants used for preparation for green manure:

- Have fast growth rates.
- Have high nitrogen content.
- Capable of rotting quickly.

- Capable of growing in poor conditions.

Preparation of Green Manure

- Plant the green manure crop in the field.
- Allow the crop to grow up to flowering stage.
- Incorporate it into the soil through ploughing.
- Allow the crop to decompose for two weeks.
- Prepare the field for planting the major crop.

Reasons why green manure is not commonly used/limitations:

- Most of the plants used as green manure are food crops.
- Green manure crops may use most of the soil moisture.
- Most of the nutrients are used up by soil micro-organisms in the process of decomposing the green manure.
- Planting of the major crop is delayed.

Farm Yard Manure (FYM)

- Is a mixture of animal waste and crop residues used as beddings in animal houses.

Factors that Determine the Quality of FYM

- The types of the animals used.
- Types of food eaten
- Types of litter used.
- Method of storage.
- Age of farmyard manure.
- Age of the animals used.

Preparation of FYM

- Provide beddings in the houses of farm animals.
- Animals deposit their droppings and urine on the beddings.
- Animals mix them through trampling.
- The beddings together with dung are removed and heaped under shed to decompose.
- After sometime, the materials decompose and FYM is formed.
- It can then be used in the farm

Compost Manure

- *I*s manure prepared from heaped (composted) organic materials.

Factors to consider in selecting site for making compost manure:

- A well drained place.
- Direction of the prevailing wind.
- Size of the farm.
- Accessibility.

Preparation of Compost Manure

Two methods:

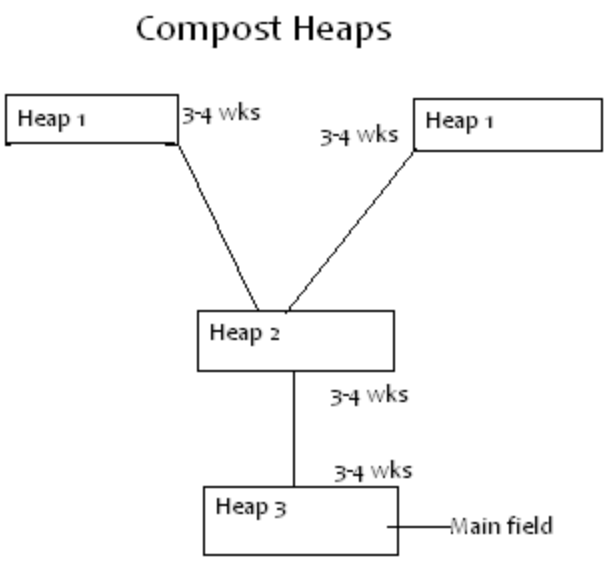
- ***Four heaps method***
- ***Indore Method (Pit Method)***

Indore Method (Pit Method)

Procedure ;

- Select a sheltered place with a shade and near the field.
- Dig a pit with the dimension 1.2m x 1.2m x 1.2m.
- Place the materials in the following order:
- Hedge cuttings or maize stalks to a depth of 30cm as a foundation
- A layer of grass, green weeds or leaves and kitchen wastes to 30cm.
- A well rotten manure/poultry droppings.
- Wood ash and phosphatic fertilizers.
- A layer of topsoil to introduce microorganism for the decomposition of organic remains.
- ***Note:*** Some water should be sprinkled to the materials to initiate the decomposition process and regulate temperatures.

Four heaps method:



Procedure

- Clear the site.
- Level the site
- Four posts 2m high are fixed 1.2m apart from four corners of the heap.
- Fix wood planks on the sides.
- Materials are placed in two heaps as in the pit method,
- The two heaps make up heap 1.
- After 3-4 weeks, the decomposed material from heap 1 is transferred to heap II.
- After another 3 - 4 weeks the material is transferred to heap III.
- After 3-4 weeks it is ready for use in the farm.

Indicators of well decomposed manure

- Absence of bad odour.
- Materials are lighter.
- Manure is brown in colour.

Advantages of Compost Manure

- One does not have to own livestock in order to prepare it.
- A lot of manure can be produced within a short time.
- A variety of materials can be used in its preparation.
- Uses locally available materials thus cheaper than the artificial fertilizers.
- Improves the soil structure.

Limitations of Compost Manure

- It releases nutrients slowly into the soil.

- Large quantities of compost manure are required to supply enough plant nutrients.
- Its preparation is labour intensive.
- It may induce soil-borne pests and diseases.

Livestock Production:

(Common Breeds)

Introduction

- The term livestock is used to refer to all domesticated animals.
- These animals include cattle, sheep, goats, poultry, pigs, rabbits, camels, bees, fish and donkeys.

The importance of keeping livestock:

- Source of food.
- Source of income.
- Cultural values.
- Source of animal power.
- Provision of raw materials for industries.
- Farmyard manure from the animals is used in maintaining soil fertility.
- Cattle dung is used in the production of biogas.

Cattle Breeds

- Cattle can be classified into two groups based on their origin.

These are;

- Indigenous cattle.
- Exotic cattle.

Indigenous Cattle

- ***Zebus*** –

They are small in size and with a distinct hump and include:

Nandi,

Bukedi

Maasai cattle.

- ***The Borana***

  These are the cattle kept in the Northern parts of Kenya.
  They are larger than the Zebus.

- Indigenous cattle are hardy hence able to tolerate the harsh environmental conditions in the tropics.
- They are the major suppliers of beef in Kenya.

Exotic Cattle

- Foreign cattle from the temperate regions.
- They have distinct breed characteristics and are classified into various breeds.

General characteristics:

- They have no humps.
- They have low tolerance to high temperatures hence popular in cool climates of the Kenya highlands ..
- They are highly susceptible to tropical diseases.
- They have fast growth rates leading to early maturity.
- They are good producers of both meat and milk.
- They cannot walk for long distances.
- They have short calving intervals of one calf per year if well managed.

Exotic cattle breeds fall under the following groups:

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

Dairy Cattle Breeds

- They include;
- Friesian,
- Ayrshire,
- Guernsey
- Jersey.

Characteristics of Dairy Cattle

- Wedge or triangular in shape.
- Large stomach.
- Docile with mild temperament.

- Large, well suspended udders and teats.
- Lean bodies.
- Lean and smooth neck.
- Large and long mammary milk wells and veins.
- Cylindrical; uniform and well spaced teats.
- Wide and well set hindquarters to accommodate the udder.

Friesian-Holstein (largest of all dairy breeds)

- ***Origin:*** Holland
- ***Colour:*** Black and white
- ***Size:*** Cow weighs 550-680kgs Bull weighs 950 kg.
- Highest milk producers of all dairy breeds about 9150 kg per lactation but with least butterfat content; 3.5%

Ayrshire

- ***Origin:*** Scotland
- ***Colour****:* White with brown markings.
- *Size:* Cow weighs 360-590kgs Bulls weighs *500-720kg.*

Conformation:

- Straight top lines, horns are long and face upwards.
- Milk production is second to Friesian about 6100kg per lactation with butter content of about 4%.

Guernsey

- ***Origin:*** Guernsey Island off the coast of France.
- ***Colour:*** Yellowish brown to red with white legs, switch and girth ..
- ***Size:*** Bulls 540-770kg. Cow weighs 450- 500kgs

Conformation:

- Udders are less symmetrical.
- Average milk production is about 5185kg per lactation with a butterfat content of 4.5% hence the yellow colour of milk.

Jersey *(smallest of all the dairy breeds)*

- ***Origin:*** England
- ***Colour:*** Yellow brown with black muzzle and switch.
- ***Size:*** Bulls weigh 540-700kg. Cow weighs 350-450kgs

Conformation:

- Dished forehead, have straight top-line and level rumps with sharp withers.
- Have protruding black eyes.

- Average milk production 1270kg per lactation of butterfat content 5%.
- They tolerate high temperatures.

Beef Cattle

Examples:

- Aberdeen Angus,
- Hereford,
- Shorthorns,
- Galloway,
- American Brahman,
- charolais
- Santa Getrudis.

Characteristics of Beef Cattle

- Blocky or square conformation.
- Have thick muscles or are well fleshed.
- Early maturing.
- Deep chest and girth and short legs.
- Straight top and lower lines.

AberdeenAngus

- ***Origin:*** North East Scotland.
- ***Colour:*** Black
- ***Shape:*** Cylindrical, compact and deep; It is polled.

Size:

- Mature bulls weigh 900kg.
- Mature cows weigh 840kgs.
- It is found in Timau area of Kenya

Hereford

- ***Origin:*** England.
- ***Colour:*** Deep red and white-faced.
- ***Size:*** Average weight of bulls is 1000kg.
- Cows weigh 840kgs.
- It is found in areas such as Naivasha.

Shorthorn

- ***Origin:*** England.
- Has easy fleshing ability
- ***Colour:*** Red, Roan or white
- ***Shape:*** Cylindrical, compact and deep.
- It is polled.

Size:

- Bulls weigh 700-900kg,
- cows weigh 545-630kgs.

Galloway

- ***Origin:*** Scotland.
- ***Colour:*** Black
- Kept in the highland areas like Molo in Kenya.

Charolais

- ***Origin:*** France.
- ***Colour:*** Creamy white.
- ***Size:*** Bulls weigh 1200kg, cows weigh 1000kgs.
- It is found in ranches in Laikipia District.

Dual Purpose Breeds

Examples: Sahiwal, Red Poll and Simmental.

Sahiwal

- ***Origin:*** India and Pakistan ..
- ***Colour:*** reddish brown.
- ***Size:*** Bulls weigh 650kg, and **cows** 400kg.
- Milk production averages 2700-3000 per lactation with a butter fat content of 3.7%.
- It has a pendulous udders which does not let down milk easily.
- It is therefore said to be a difficult milker.
- It is kept in semi-arid areas such as Naivasha.

Red Poll

- ***Origin:*** England.
- ***Colour:*** Deep red with a white nose.
- ***Conformation:*** Polled-deep girth and short legs.
- *Kept in semi-arid* areas such as Nakuru, Mogotio.

Simmental

- ***Origin:*** Switzerland.
- ***Colour:*** Light red and white patches on the head.

Conformation:

- It has broad and straight back, with well-sprung ribs and deep girth.
- It is well fleshed at rear quarters, well suspended udders and large teats.

Sheep Breeds:

Purpose of Keeping Sheep;

- Meat (mutton).
- Wool production.

Exotic Sheep

- ***Wool breeds*** -for example merino.
- ***Dual purpose-*** for example Corriedale, Romney marsh.
- ***Mutton breeds*** -for example Hampshire Down, Dorpers.

Merino

- ***Origin:*** Spain

Characteristics:

- It has white face and its lips and nostrils are pink in colour.
- Rams have horns which are spiral in shape.
- It is susceptible to foot rot, worm and respiratory diseases.

Corriedale

- ***Origin:*** New Zealand.
- ***Size:*** Rams 85 - 90kg. Ewes 60-- 85 kg
- This is a dual-purpose breed with white open face and white spots on the legs.
- It is hornless and hardy.

Romney Marsh

- ***Origin:*** England.
- ***Size:*** Rams 100 - 115kg.
- Ewes 84- 100 kg
- It is a dual-purpose breed which s hornless with wide poll and black nostrils and lips.
- It is average in prolificacy.

- It is resistant to foot rot diseases and worm infestation.

Hampshire Down

- ***Origin:*** England.
- ***Size:*** Rams 125kg.
- Ewes 80-100 kg
- It is a mutton breed which is early maturing, hardy and prolific.
- Fleece is of poor quality because of the black fibres.
- Lambing percentage is 125-140.

Dorper

- Is a crossbreed of Dorset horn and black head Persian sheep.
- It is mutton breed.

Dorset Horn

- Dual purpose breed of sheep.
- Indigenous Breeds of Sheep
- Their bodies are covered with hair.
- Their classification is based on their tails and their names vary according to different tribes.

Characteristics;

- Thin tailed sheep found in West Africa.
- Fat tailed such as Maasai sheep.
- Fat rumped sheep.

Maasai Sheep

- Found in South Western Kenya and Northern Tanzania.
- Size: Ram 38kg,
- Ewe 20-30kg.
- Colour: Red and brown.
- These are early maturing with long legs and small pointed horns.

Black Head Persian Sheep

- ***Origin:*** South Africa
- ***Colour:*** White with black head and neck.
- It is polled with a big dewlap, fat rump and a curved tail..

Goats

Goats well adapted to a wide range of environmental conditions because of the following characteristics:

- They feed on a wide range of vegetation.
- They require very little amount of water.
- They are tolerant to high temperatures.
- They are fairly resistant to diseases.
- They can walk long distances without losing weight.

Indigenous Goat Breeds

- Galla (white in colour). Adult female can weigh 25kg.

- Somali (Boran): Found in Northern Kenya (white in colour).
- Turkana/Samburu: (Long hair and bearded.
- Mubende: (Black) (40-45kg). These are small and hardy and are kept for meat and milked by the pastoralists.

Exotic Breeds

Boer goat

- ***Origin:*** South Africa
- ***Colour:*** White
- Has long ears and long hair on their bodies.

Anglo-Nubian

- ***Origin:*** North East Africa
- ***Colour:*** Roan and White
- These have long legs, lopped ears and are polled.
- They produce 1-2 litres of milk per , day.

Jumnapari

- ***Origin:*** India
- ***Colour:*** White, black and fawn.
- They are horned, have large lopped ears
- Produce 1-1.5_litres of milk per day.

Toggenburg

- ***Origin:*** Switzerland
- ***Colour:*** White patches on the body, white stripes on the face and neck.
- Erect forward pointing ears and polled.
- Can produce 2-3 of milk per day.

Saanen

- ***Origin:*** Switzerland.
- ***Colour:*** White
- They have erect, forward pointing ears and polled.
- Can produce 2-3 litres of milk per day.

Angora

- ***Origin:*** Angora in Asia.
- ***Colour:*** White
- It is kept for wool production.

French alpine. Pigs

Characteristics:

- They are sparsely haired and therefore cannot withstand cold.
- Pigs wallow when it is hot due to absence of sweat glands.
- They breathe fast when it is hot.
- They have bristles instead of hair.

Breeds

Large White

- ***Origin:*** Britain
- _ Kept for bacon and pork production.
- Long, large and white in colour.
- Ears straight and erect.
- Has dished face and snout.
- Most prolific and with good mothering ability.
- Fairly hardy.

Landrace

- ***Origin:*** Denmark

- White and longer than large white. _
- Ears drooping.
- Good for bacon production.
- Very prolific with good mothering ability. _
- Requires high level of management.

Wessex Saddle

- ***Back Origin:*** England
- ***Colour:*** Black with white forelegs and shoulders.
- Straight snout and drooping ears. _
- Good for bacon and pork.
- Good for keeping outdoors.
- Excellent mothering instincts.

Other pig breeds include:

- Berkshire,
- Middle-white
- Duroc Jersey pig.

Pigs can be crossed to obtain hybrids or crosses.

Advantages of Crosses

- Increased litter size. _
- Early maturing.
- _ Increase in body length.
- _ High proportion of lean meat to fat.

Poultry Breeds

There are three types of chicken breeds:

- The light breeds kept for egg production.
- The heavy breeds kept for meat production.
- Dual purpose breeds - kept for both eggs and meat production.

Characteristics of Light Breeds

- Never go broody hence poor sitters.
- Excellent layers (over 220 eggs per year).
- Poor meat producers (hens can attain 2kg; cocks 3kgs)
- Very nervous and exhibit high degree of cannibalism.

- Hen's comb is large and bent over one eye and cock's comb is large with 5 - 6 serrations.

Examples:

- Leghorns,
- Anconas,
- Silkies,
- Minorcas.

Characteristics of Heavy Breeds

- Can lay few eggs and provide good meat as broilers.
- Can go broody.
- Heavier and bigger in size.
- Grow fast.

Examples:

- Light Sussex,
- Cornish Dark
- White.

Characteristics of Dual-Purpose Breeds

- Go broody.
- Have good meat.
- Disease resistant (do not require high standard of management).
- Rarely exhibit cannibalism.

Examples: Rhode Island Red.

Hybrids

- These are developed by crossing two different breeds.
- They are superior in performance.
- Can attain 2kg in 56 days for broilers and layover 200 eggs per year for layers.

Examples:

- Shavers,
- Thombers
- Isabrown.

Rabbits

Kept for the following reasons:

- To provide meat, fur, hair or wool.

- To provide skin for leather.
- To provide manure.
- As pet animals.
- Used for research purposes.

Breeds

- ***Californian white:*** white, very prolific black ears, nose and feet).
- ***New Zealand white:*** (white with pink eyes - good for meat).
- ***Flemish giant*** (dark grey - good for meat).
- ***Angora rabbit*** (white, kept for wool production).
- ***Chinchillah*** (greyish, kept for its fur).
- ***Earlops*** (white with droopy ears).
- ***Kenya white*** (white, smallest of breeds).

Camels

Kept for;

- Transport,
- Racing,
- To provide milk, meat and wool.

There are two species of camels.

Dromedary (Camelus dromedarius)

- ***Origin:*** Arabia and Syria
- Are single humped, have light body
- Good for racing and rapid transport.

Bacterian (Camelus bacterianus)

- ***Origin:*** Central Asia
- Has double humps, heavier and has shorter legs.
- Can live in cold regions hence its thick and long coat acts as insulation.
- Capable of shedding the coat during spring.

Terms used to describe livestock in different age, sex and use.

Livestock		*Adult*	*Replacement Stock*		*Young*	*Users)*
Species	*Male*	*Female*	*Male*	*Female*	*One*	
Cattle	Bull	Cow	Bullock	Heifer	Calf	Dairy - milk Beef-meat

Sheep	Ram	Ewe	Ram	Hogget	Lamb	Mutton - meat Wool sheep -wool
Goat	Buck or	Doe or	Buck Billy	Doe Nanny	Kid	Dairy - milk Mutton - meat
Pigs	Boar	Sow	Boar	Gilt	Piglet	Pork - meat Bacon -cured
Poultry	Cock	Hen	Cockerel	Pullet	Chick	Broilers - meat Layers - eggs
Rabbits	Buck	Doe	Buck	Doe	Kindling	Meat
Camel	Bull	Cow	Bull	Heifer	Calf	Pack, trained for riding, racing milk, meat, fur

Agricultural Economics I

(Basic Concepts and Farm Records)

Introduction

- Economics is the study of how man and society chooses to allocate scarce productive resources to produce various commodities, over time, and distribute them among various consumers in society.
- It attempts to explain how man can best use the limited resources to produce goods and services which satisfies his needs with minimum wastage or loss of these resources

Example;

food,
clothing
shelter

Agricultural economics is therefore defined as a science that aims at maximizing output while minimizing costs by combining the limited supplies of goods and services for use by the society over a certain period of time.

- **These are;**

land,
capital,
labour

management

Basic economic Principles

Scarcity

- Economic scarcity means resources are limited in supply relative to demand.
- This principle implies that there is no time that man can have enough resources to satisfy all his need or desires

Choice/Preference

- Human wants are many and varied and means of satisfying them are limited.
- Therefore, man has to make a choice among the alternatives in order to use the resources available.
- Man does this by satisfying the most pressing needs first.
- This is called **scale of preference.**

Opportunity Cost

- Opportunity cost is the revenue forgone from the best alternative.
- It exists only where there are alternatives.
- Where there are no alternatives the opportunity cost is equal to zero.
- Opportunity cost helps in decision making.

Farm Records

- Farm records are documents kept in the farm
- They show farm activities carried out over a long period of time
- Or information kept in the farm in written form, about the farm and all activities in it.

Uses of Farm Records

- Show the history of the farm
- Show whether the farm is making a profit or loss.
- Show all the assets and liabilities of the farm which can be used to value the farm.
- Help in supporting insurance claims on death, theft, fire or loss of farm assets.
- Help in tax assessment to avoid over taxation.
- Used as a guide in planning and budgeting.
- Helps to detect losses or theft in the farm.
- Make it easy to share profits or losses in partnerships.
- Help in settling disputes among heirs to estate if the farmer dies without a will.
- Provide labour information on terminal benefits for a worker.

Type of Farm Records

- **Production Records** - Show the total yield and yield per unit of each enterprise.

- **Inventory Records** - A record of all permanent and consumable goods in the farm.

Consumable Goods Inventory

Date	*Commodity Item*	*Quantity*	*Date*	*Issued to*	*Quantity*	*balallce Stock*

- **Field Operation Records** - Show in details all field practices carried out together with the input used for all the crop enterprises.
- **Breeding Records** –

  Show all the breeding activities in the farm.

  From these records it is possible to select the prolific animals and cull the infertile ones.
- **Feeding Records** – A record of the types of feeds used in the farm and their quantities.
- **Health Records** –

  Indicates the health conditions of the animals in the farm.

  From these records it is possible to:

Select and cull animals on health grounds.

Soil Fertility II

(Inorganic Fertilizers)

Introduction

- Plant nutrients occur in the soil in form of soluble substances.

- These substances are taken in by the plants in different quantities depending on their roles in the plant tissues.

Essential Elements

- These are nutrients needed by plants for various uses.
- They are divided into two broad categories namely:

  Macronutrients

  micronutrients.

Macro-nutrients

- These are also referred to as major nutrients.
- They are required by the plant in large quantities.

They include;

- carbon,
- hydrogen,
- oxygen,
- nitrogen,
- phophorus,
- potassium,
- sulphur,
- calcium
- magnesium.

Nitrogen, phosphorus and potassium are referred to as **fertilizer elements,**
Calcium, magnesium and sulphur, are referred to as **liming elements.**

Role of Macronutrients in Plants

Nitrogen (NO_3,$NH4^{++}$)

Sources:

- Artificial fertilizers
- Organic matter
- Atmospheric fixation by lightning
- Nitrogen fixing bacteria.

Role of Nitrogen in Plants

- Vegetative growth
- Chlorophyll formation
- Build up of protoplasm.
- Improves leaf quality in leafy crops such as tea and cabbages.

Deficiency Symptoms

- Yellowing of the leaves/chlorosis.
- Stunted growth.
- Premature ripening.
- Premature shedding of the leaves.
- Light seeds.

Effect of Excess Nitrogen

- Scorching of the leaves.
- Delayed maturity.

Loss of Nitrogen From the Soil:

- Soil erosion.
- Leaching.
- Volatilization.
- Crop removal.
- Used by microorganisms.

Phosphorus ($H_2 Po_4$, HPO^{2-}_4 P_2O_5)

Sources:

- Organic manures
- Commercial fertilizers
- Phosphate rocks

Role of Phosphorus

- Encourages fast growth of the roots.
- Improves the quality of the plant.
- Hastens maturity of the crops.
- Influences cell division.
- Stimulates nodule formation in legumes.

Deficiency symptoms

- Growth of the plant is slow.
- Maturity is delayed.
- Leaves become grey, purple in colour.
- Yield of grains, fruits and seed is lowered.

Loss of Phosphorus From the Soil

- Soil erosion.
- Leaching
- Crop removal
- Fixation by iron and aluminium oxide.

Potasium (K^+, K_2O)

Sources;

- Crop residue and organic manures.
- Commercial fertilizers
- Potassium bearing minerals e.g. feldspar and mica.

Role of Potassium in Plants

- Increases plant vigour and disease resistance.
- Increases the size of grains and seeds.
- Reduces the ill-effects due to excess nitrogen.
- Prevents too rapid maturation due to phosphorus.

Deficiency Symptoms

- Plants have short joints and poor growth.
- Plants lodge before maturing.
- Leaves develop a burnt appearance on the margin.
- Leaves at the lower end of the plant become mottled, spotted or streaked.
- In maize, grains and grasses firing starts at the tip of the leaf and proceeds from the edge usually leaving the midrib green.

Loss of Potassium From the Soil

- Crop removal.
- Leaching.
- Soil erosion.
- Fixation in the soil.

Calcium (Ca^2+)

Source:

- Crop residues and organic manures.
- Commercial fertilizers.
- weathering of soil minerals.
- Agricultural limes for example ***dolomite, limestone***.

Role of Calcium in Plants

- Improves the vigour and stiffness of straw.
- Neutralizes the poisonous secretions of the plants.
- Helps in grain and seed formation.
- Improves the soil structure.
- Promotes bacterial activity in the soil.
- Corrects the soil acidity.

Deficiency symptoms

- Young leaves remain closed.
- There are light green bands along the margins of the leaves.
- Leaves in the terminal bud become hooked in appearance there is a die-back at the tip and along the margins.

Loss of Calcium

- Crop removal
- Leaching
- Soil erosion

Magnesium (Mg^{2+})

Sources:

- Crop residues and organic manures
- Commercial fertilizers
- Weathering of soil minerals.
- Agricultural limes.

Role of Magnesium in Plants

- Forms part of chlorophyll.
- Promotes the growth of the soil bacteria and enhances the nitrogen fixing power of the legumes.
- Activates the production and transport of carbohydrates and proteins in the growing plant.

Deficiency symptoms

- Loss in green colour which starts from the bottom leaves and gradually moves upwards.
- The veins remain green.
- Leaves curve upwards along the margins.
- Stalks become weak and the plant develops long branched roots.
- The leaves become streaked.

Sulphur (So_4^{2-}, SO_2)

Sources:

- Commercial fertilizers.
- Soil mineral containing sulphides
- Atmospheric sulphur from industries.
- Rain water

Role of Sulphur in Plants

- Formation and activation of coenzyme-A.
- Sulphur is a constituent of amino acids.
- Influence plant physiological processes.

Deficiency Symptoms

- Small plants/stunted growth.
- Poor nodulation in legumes.
- Light green to yellowish leaves/ chlorosis.
- Delayed maturity.

Micro-nutrients

- Also referred to as trace or minor nutrients.
- They are required in small quantities/traces.
- They are essential for proper growth and development of plants.

They include;

- Iron,
- Manganese,
- Copper,
- Boron,
- Molybdenum
- Chlorine.

Role of Micronutrients and Their Deficiency Symptoms

- ***Copper***

  Role in oxidation-reduction reactions.

  Respiration and utilization of iron

  Deficiency symptoms-**yellowing of young leaves**.

- ***Iron***

  Synthesis of proteins.

  Takes part in oxidation-reduction reactions.

  Deficiency symptoms - **leaf chlorosis**

- ***Molybdenum***

  Nitrogen transformation in plants.
  Metabolization of nitrates to amino acids and proteins
  Deficiency symptoms -**leaf curl and scathing.**
- ***Manganese -*** Same as molybdenum.
- ***Zinc***

  Formation of growth hormone.
  Reproduction process
  Deficiency symptoms - **white bud formation.**
- **Boron –**

  Absorption of water.
  Translocation of sugar

Inorganic Fertilizers

- These are chemically produced substances added to the soil to improve fertility.

Classification According to:

- **Nutrients contained**

  Straight - contain only one macronutrient.
  Compound fertilizers - contain more than one macronutrient
- ***Time of application***

  Some applied when planting.
  Top dressing after crop emergence
- ***Effects on the soil pH.***

  Acidic fertilizers.
  Neutral fertilizers.
  Basic fertilizers.

Properties and Identification of Fertilizers

Nitrogenous Fertilizers

Characteristics

- Highly soluble in water.
- Highly mobile in the soil hence it is applied as a top dress.
- Easily leached because of the high solubility hence does not have residual effect on the soil.
- Has scorching effect on young crops during wet seasons.
- Easy to volatilize during hot season.

- They have a tendency to cake under moist conditions.
- They are hygroscopic hence should be stored in dry conditions.

Examples:

- ***Sulphate of Ammonia (NH_4) 2 SO_4·***

  Physical appearance:

  white crystals,

  Has acidic effect,

  Contains 20% N.

- ***Ammonium Sulphate Nitrate [$(NH_4)_2 SO_4$+ $NH_4 NO_3$]***

  Colour: granules which appear yellow orange,
  less acidic,
  contains 26% N.

- ***Calcium Ammonium Nitrate (CAN)***

  Colour: greyish granules,

  neutral in nature,

  contains 21 % N.

- ***Urea***

  Colour: small whitish granules
  Easily leached or volatilized,
  contains 45- 46%N.

Phosphate Fertilizers

- Has low solubility and immobile.
- Non-scorching.
- Has a high residual effect hence benefit the next season's crop.
- Easy to store because they are not hygroscopic.

Examples;

- ***Single super-phosphate***

  Appearance: whitish, creamy white granules,

  contains **20-21 % P_2O_5**

- ***Double super-phosphate***

  Appearance: dark greyish granules,

  Contains ***40-42% P_2O_5***

- ***Triple super-phosphate***

  Appearance: small greyish granules,

Contain ***44-48% P2O5***

Potassic Fertilizers

Characteristics:

- Has moderate scorching effect.
- Moderately soluble in water.
- Most Kenyan soils have sufficient potassium.

Examples;

- ***Muriate of Potash (KCl)***

  Contain 60 - 62% K_2O

  Slightly hygroscopic.

  Appearance amorphous white.
- ***Sulphate of Potash (50% K_2O)***

Compound or Mixed Fertilizers

- These are fertilizers which supply 2 or more of the macronutrients.

Examples;

- ***Mono ammonium phosphate.***
- ***Di-ammonium phosphate***
- ***20:20:20, 23:23:23***

Advantages of application of compound fertilizers

- Saves time and money.
- Mixture gives improved storage properties and better handling.

Disadvantages of compound fertilizers application

- Expensive.
- Wasteful.
- Mixing may not be thorough.
- Incompatibility of the individual fertilizers.

Methods of fertilizer application

- ***Broadcasting*** - random scattering of the fertilizers on the ground.
- **Placement method** - application of fertilizers in the planting holes.

- ***Side dressing*** - fertilizer is placed at the side of the plant within the root zone, in bands or spot-rings.
- ***Foliar spraying*** - specially formulated fertilizer solution applied on the foliage in spray form.
- ***Drip method*** - applied through irrigation water.

Determination of Fertilizer Rates

Contents of fertilizers are expressed as fertilizer grade or fertilizer analysis.

- Fertilizer grade indicate the guaranteed minimum of the active ingredients (N, P_2O_5, K_2O) in the mixture.
- It is expressed as a percentage on a weight to weight basis or percentage by weigh

Example 10:20:0 means for every 10kg of the mixture there are 10kg of nitrogen, 20kg of P_2O_5 and 0kg of K_2O.

Example

A farmer was asked to apply fertilizers as follows:

- 60 kg/ha nitrogen (top dressing)
- 60 kg/ha P_2O_5 (in planting hole).
- 60 kg/ha K_2O.

How much sulphate of ammonia (20%) would be required per hectare?
How much double super-phosphate (40%) P_2O_5would be required per hectare?
How much muriate of potash (*50%* K_2O) would be required per hectare?

Answer/Solution

- Sulphate of ammonia (SA) which gives 60kg/ha N

  $= \frac{60}{20} \times 100 = 300$kg SA
- Double super phosphate (40% P_2O_5)which gives 60kg/ha P_2O_5

  $\frac{60}{40} \times 100 = 150$kg DSP
- Muriate of potash (60% K_2O) which gives 60kg/hK_2O

  $= \frac{60}{60} \times 100 = 100$kg muriate of potash

Example

A farmer was asked to apply fertilizers as follows:

- 200kg/ha of DSP (40% P_2O_5
- 150kg/ha of muriate of potash (60% K_2O)

- 150kg/ha of sulphate of ammonia (20% N)

How much P_2O_5 did the farmer apply per acre?
How much K_2O did the farmer apply per hectare?
How much N did the farmer apply per hectare?

Solution/Answer

- P_2O_5 applied per hectare from 200kg of DSP

$$= \frac{40}{100} \times 200 = 80\text{kg/ha } P_2O_5$$

- K_2O_5 applied per hectare from 150kg of muriate of potash

$$= \frac{60}{100} \times 150 = 90\text{kg/ha } K_2O$$

- ***N*** applied per hectare from 150kg/ha sulphate of ammonia

$$= \frac{20}{100} \times 150 = 30\text{kg/ha N}$$

Soil Sampling

- Refers to obtaining of small quantity of soil that is representative in all aspects of the entire farm.

Soil Sampling Procedures

- Clear the vegetation over the site.
- Dig out soil at depths of 15-25cm.
- Place the dug out soil in a clean container.
- Mix thoroughly the soil in the container.
- Take a sample and send it to National Agricultural Laboratory for analysis.
- The container carrying the sample should be properly labeled as follows:
  - Name of the farmer,
  - Location,
  - District
  - Address of the farmer.

Sites to Avoid

- Dead furrows, ditches.
- Swamps
- Near manure heaps.
- Recently fertilized fields
- Ant hills.
- Under big trees.

- Near fence lines or foot paths.
- Do not put them in containers which are contaminated with fertilizers or other chemical containers.

Methods Of Soil Sampling:

- Zigzag method
- Traverse method

Soil Testing

- Soil testing is the analyzing of the soil sample to determine certain qualities of the soil.

Importance of Soil testing:

- To determine the value of the soil hence determine the crop to grow.
- To determine the nutrient content hence find out the type of fertilizer to apply.
- To determine whether it is necessary to modify the soil pH for a crop.

How Soil pH affects Crop Production

- Influences the physical and chemical properties of the soil.
- Affects the availability of nutrients.
- Influences the incidences of soil borne diseases.
- Determine the type of crop to be grown at a given area.

Methods of pH Testing

- Universal indicator solution
- pH meter

Know the course of action to be taken in the event of a disease and maintenance of good health.
Know the prevalent diseases.
Calculate the cost of treatment.

- **Marketing Records** show commodities sold, quantities and value of all the sales.

Labour Records - show labour utilization and labour costs.