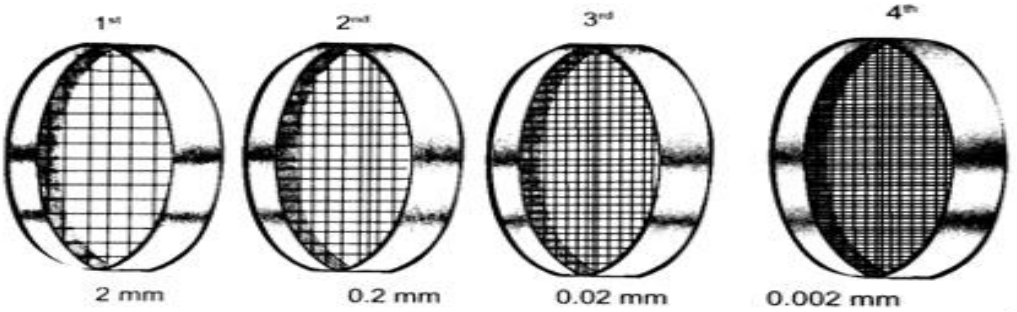
NEW SYLLABUS BASED NOTES FOR FORM 2

AGRICULTURE

COMPILED BY

PHILLIP MLOWOKA GUDULU CHIRWA



sieves meshes of different diameters

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BY

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Passing agriculture at junior has never been easy and straight forward. This pamphlet has brought all the resources which are indispensable so

as to minimize lavishness of precious time probing for valuable information in different books.

ACKNOWLEDGEMENT

My profound thanks should go to my spouse Chimwemwe Chakwira who persistently (tirelessly) encouraged me to work as if there is no tomorrow so that this pamphlet should be finalized despite the myriads of predicaments l encountered. I would be doing unfairness if I do not recognize the omnipresent **GOD** for the free endowment of life.

Special dedication to my children **MADALITSO CHIRWA** and son **EMMANUEL CHIRWA**

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Unit 1: SOIL

Soil Composition

- soil is made up of five components namely
  - inorganic constituents(minerals)
  - organic matter(humus)
  - living organism
  - soil water (moisture)
  - soil air

a. **soil water**

- function of soil water include the following
  - It acts a component of the cell protoplasm thereby proving support to the plants. In herbaceous plants it makes the plants to be turgid.
  - Acts a medi7u,m through which plants nutrients dissolve before being transported to up to the plants
  - Water is the raw material of photosynthesis
  - Loss of soil water by transpiration has cooling effect on plants
  - Water is necessary for microbial activities in the soil
  - Soil water creates a suitable condition for seed germination

Forms of soil water

- Superfluous water
- Hygroscopic water
- Capillary water

i. Superfluous water

- Soil water found in large air spaces(macrospores) in soil particles
- Held together by gravitational forces. Once these paces are saturated with water, the soil becomes waterlogged.
- This type of water is available for plants use

ii. Hygroscopic water

- Water found in form of thin film on the surface of the soil particles. It is held by strong forces and is not available for pants use

iii. Capillary water

- Water which occupies the micropores in the soil. It is held by strong adhesive and cohesive force. It the water that is readily available and beneficial to plants.

Experiment 1: to determine the percentage of water in a soil sample

Apparatus and materials

- Weighing balance
- Evaporating dish
- Sample of the garden soil
- Tripod stand
- Source of heat for example, Bunsen burner

Procedure

- Weight the evaporating dish
- Put 50g of the soil sample on the evaporating dish

- Heat the soil to $105℃$ over a Bunsen burner.
- Stir the soil as you hest. Ensure that all the water has evaporated.
- Remove the evaporating dish from the source and let it cool. You may use a desiccators for faster cooling
- Re-weigh the dish with the soil, and record the mass

b. **Soil air**
   - Is a mixture of gases (nitrogen, oxygen, carbon dioxide and inert gases)

Importance of air in the soil

- Necessary for respiration of plants roots and animals in the soil
- Nitrogen during fixation is converted to nitrate
- Good aeration increases microbial activities in the soil
- Good air circulation in the soil is necessary because it removes excess carbon dioxide that may be poisonous o plants

Experiment 2: to determine the percentage of air in a soil sample

Apparatus and materials

- $250cm^3$ measuring cylinder
- Sample of garden soil
- Distilled water
- Beaker

Procedure

- Put $100cm^3$ of water into $250cm^3$ measuring cylinder
- Using a $100cm^3$ beaker. Put the soil up to the $100cm^3$ mark
- Empty the soil into the measuring cylinder and shake well. Observe the escaping bubbles
- After all the bubbles have escaped, record the final reading of the mixture

Results

- Note that the final level of water plus soil is below the expected $200cm^3$ mark. This is because soil air escaped thus reducing the volume of the mixture.

c. **Organic matter**
   - It is derive from remains of plants and animals.
   - It releases nutrients and humus after decomposition which binds the soil particles thereby improving soil structure. It is dark in colour hence it raise the soil temperature.

Experiment 3: to find the percentage of humus on a soil sample

Apparatus and materials

- Evaporating dish
- Weighing scale
- Source of heat
- Sample of garden soil

Procedure

- Take some soil sample from the garden

- Weigh 100g of the soil
- Weigh the evaporating dish and record its mass
- Put the soil in the evaporating dish
- Heat the soil over a Bunsen burner at around 105℃ to eliminate the water
- Cool and re-weight, then reheat the soil at the soil at the same temperature until a constant mass is obtained.
- Heat the soil strongly until all the humus is completely burnt
- Cool it and re-weigh the soil.
- Calculate the parentage of the organic matter using the original mass and the final mass.

d. **Inorganic matter**

➢ These rise from rock disintegration. Examples include the following; calcium, sulphur and potassium. Mineral matter consists of clay, silt and silt which are referred as fractions. These fractions vary in size and are classified according to their diameter.

Experiment 4: to show that soil contains mineral matter of different sizes

Touch and feel method

Apparatus and materials

- Samples of clay and sandy soils

Procedure

- Hold each of the soil samples between the thumb and first finger
- Rub the soil between the thumb and finger
- Record how the soil feels

Results

- Clay soil feels fine and smooth
- Sandy soil feels coarse and rough

Conclusion

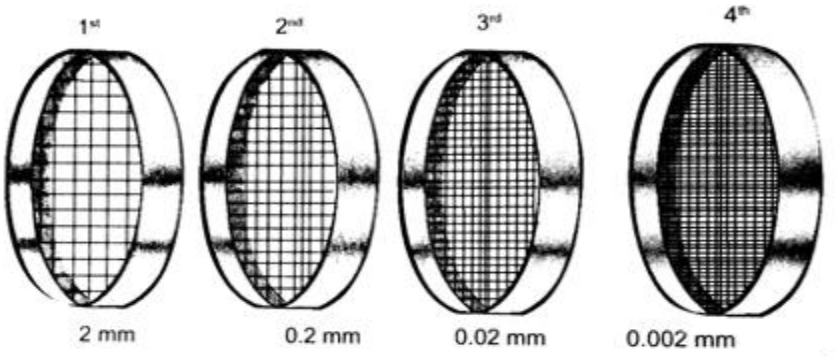
- Clay soil has small particles
- Sandy soil has larger particles.

Experiment 5: to separate mineral matter of different sizes

a. Sieves method

Apparatus and materials

- samples of garden soil
- 4 sieves of different mesh sizes (2mm,0.2mm,0.02mm and 0.002mm)



sieves meshes of different diameters

Procedure

- Grind the soil sample to break up large lumps
- Arrange the sieves according to size of mesh sizes(large hole on top and smaller one at the bottom)
- Put soil in a series of sieves of different sized meshes and shake vigorously.

Results

- **First sieve:** coarse sand retained, but fine sand ,silt and clay pass through
- **Second sieve:** fine sand retained, but silt and clay pass through
- **Third sieve:** silt retained but clay passes through
- **Fourth sieve:** clay retained

Conclusion

- Soil is made up of different sized particles

b. Sedimentation method

Apparatus and materials

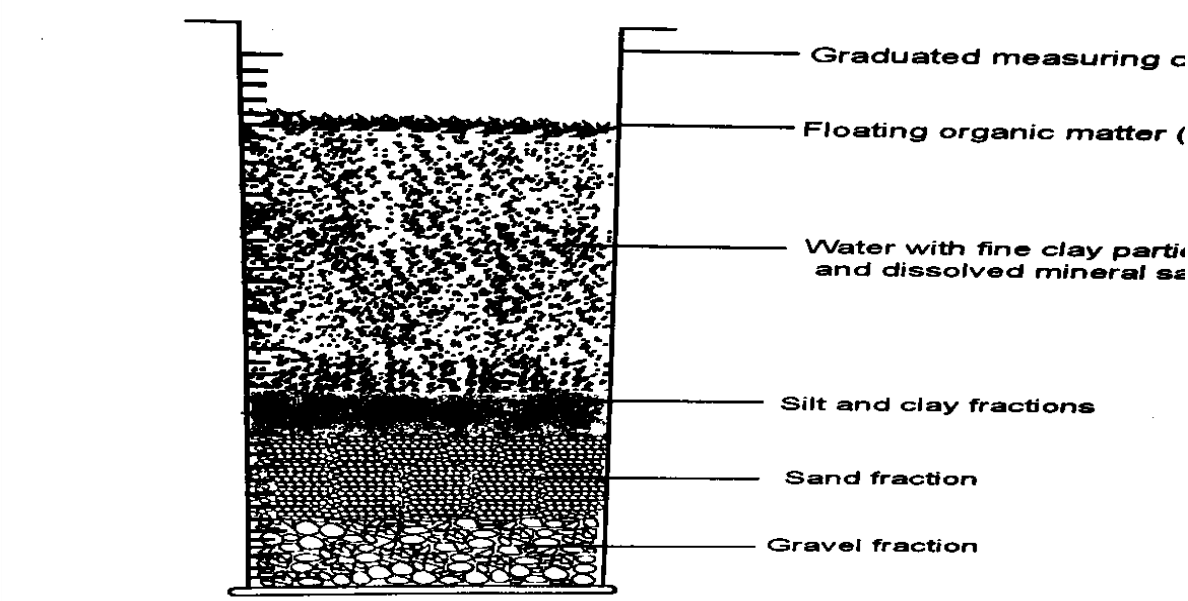
- Garden soil
- $250cm^3$ measuring cylinder
- $sodium$ carbaonate

Procedure

- Put 50g garden soil in $250cm^3$ measuring cylinder
- Add 10g of sodium carbonate. This helps to disperse the particles
- Add $200cm^3$ of water
- Cover the mount of the cylinder with your palm and shake vigorously
- Leave the contents to stand for about an hour
- Observe the settled layers

Observation

- The soil particles settle according to their sizes.
- The largest and heaviest were at the bottom and the smallest and lightest settle at the top



e. **Living organism**
   - These include the following rodents, worms, insects and micro-organism. Play vital role in soil formation. Bacteria helps in decomposing organic matter while other bacterial like rhizobium fix nitrogen in the soil.
   - All living things respire and carbon dioxide is released as a by-products. Carbon dioxide is tested using lime water, carbon turns lime water milky.

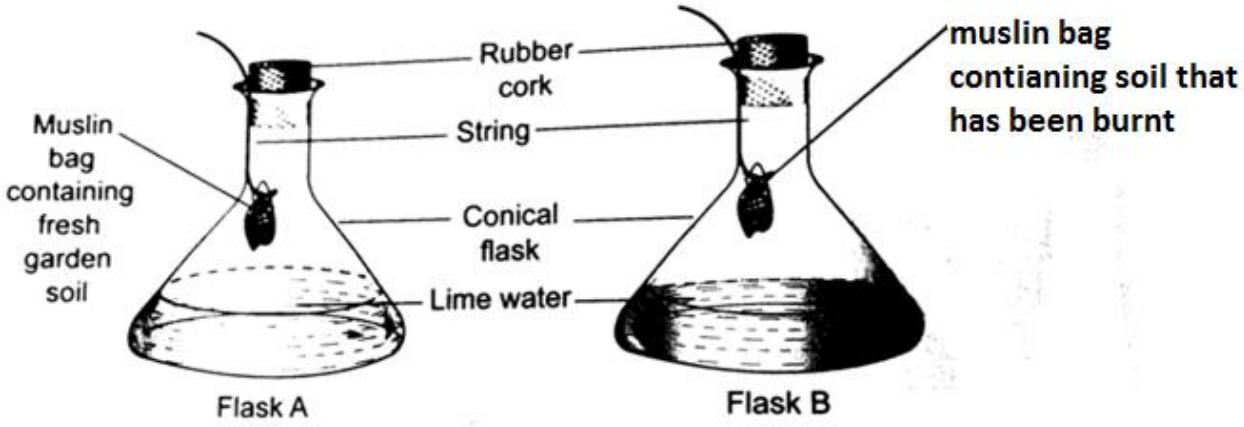
Experiment 6: to show the presence of micro-organisms in the soil

Apparatus and materials

- Two $250cm^3$ conical flasks
- Rubber stoppers
- Fresh garden soil
- Muslin bags
- Source of heat
- Lime water

Procedure

- Put a sample of the soil in muslin bag and tie it with a string
- Put an equal amount of burnt soil (**control treatment**) in another muslin bag and tie it with a string.
- Suspend each muslin bag in a conical flasks containing lime water and label them A and B
- Cork the conical flasks tightly
- Leave the set up for 6-12 hours



Results

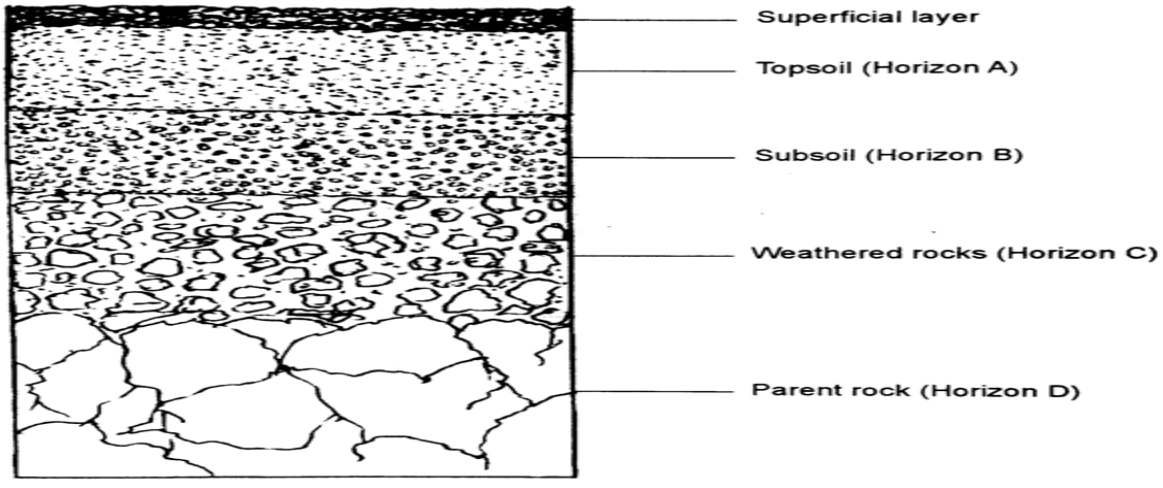
- Lime in conical flask **A** turns milky, while there is no change in the lime water in water contained in flask **B.** burning kills the living organisms so there is no production of carbon dioxide in the flask with burnt soil.

Conclusion

- Soil contains micro-organisms

Soil profile

- *Soil profile refers to the vertical arrangement of different layers of the soil from the ground surface to the bedrock.*
- These layers are called horizons and are very distinct if soil has been formed for over a long period of time.
- **The profile is made up of four layers (horizons)a namely**
- Top soil (horizon A)
- Subsoil (horizon B)
- Weathered rocks (horizon C)
- Parent or bedrock (horizon D)



soil profile

a. Top soil

- Layer found on the surface and contains decomposed and decomposing organic matter which ploughed into soil there by adding organic matter to soil.
- It is dark in colour due to presence of humus and it is rich in nutrients and also well aerated.
- However it is subject to leaching.
- Microorganism are found her since it s well aerated
- Most plants around here.

b. **Subsoil**
- Found beneath top soil and it more compact and less aerated then top soil. Minerals are deposited here after leaching in top soil and therefore it is called a layer of accumulation.
- Made up of larger soil particles and it is lighter in colour due to absence of hums.
- When it is now cultivated it forms hard pans thereby becoming impermeable to water and air.

c. **Weathered rocks**
- Third layer from top and composed of weathered rocks
- Most materials here come from bed rock
- As one move from top to down, soil particle becomes larger as they are less exposed to agents of weathering.

d. Parent material
- Also referred to as substratum. The zone exists as solid mass. It is called parent material because it is the source of inorganic matter in the soil. The water table is on this surface on this rock. The colour is determined by colour of parent material.

Effects of soil profile on crop production

i. soil depth:
- It influences the soils capacity to hold water and mineral which can be used by plants, deed soil has high water and nutrients holding capacity as compared to shallow soil.
- It also determines the choice to crops to be grown, deep rooted crops do well deep soils than in shallow soils where it may not well be anchored.
- Deep soil are less prone to erosion because have room for more water hence reducing surface runoff as most water infiltrates

ii. Compactness of the soil:
- Compacts soils have poor drainage, aeration and they also limit root penetration and tuber enlargement.
- While loosely packed soil have good aeration, drainage, good root penetration hence it is good for growing tubers.

iii. Composition of the parent rocks
- This influences the type of minerals present in soil and if parent was rich in particular minerals, the soil will also be rich in the same minerals.\

UNIT 2: SOIL FERTILITY

- a fertile soil should be provide all the necessary conditions for proper growth of crops and consequently give high yields of high quality

Experiment 1: to investigate the difference between fertile and infertile soils

Apparatus and materials

- sample of a fertile soil
- sample of infertile soil
- maize seeds
- pots or tins
- water
- ruler

Procedure

- collect a soil sample from garden where crop have been performing well, fertile soil
- Collect another soil sample from a garden where crops have been performing poorly, infertile soil.
- Put the fettle soil in the first pot
- Put an equal amount of infertile soil in the second pot
- Plant maize seed in each of the pot at the same depth.
- Water the seed in the pots
- Practice regular watering of the seed with the same quantity of water and same frequency.
- Observe the pants as they grow and note any differences
- Measure the height of each plant using a ruler on daily basis

Results

- The maize seeds germinated at the same time
- Seedlings in the fertile soil were observed to have a high growth rate compared to the seedlings in infertile soil.

Explanations

- Fertile soil provides crops will all conditions for growth since it has various minerals required for plants growth.
- Infertile soil lacks some of these essential minerals and hence plants do not show proper growth.

Conclusion

- Fertile soil allows proper growth of plants while infertile soil does not

Differences between fertile and infertile soil

Fertile soil	Infertile soil
• Contains all the minerals essential for growth	• may be lacking one or more of the minerals essential for plants growth
• has the right depth depending on the crops grown	• May be shallow with respects to the crop grown
• Has the right water holding cap city	• May hold too much water or little water to allow proper growth
• Has good porosity hence well-aerated	• May have poor porosity hence poorly aerated
• Free from excessive soil-borne pests and diseases	• May have excessive soil-borne pests and disease

Ways of maintaining soil fertility

a. Application of organic and inorganic fertilizer

- They replenish the nutrient lost from soil.

- They also buffer the soil ph, thus preventing rapid change in soil pH.
- Organic matter acts as food and shelter to soil micro-organism thus increasing microbial activities.

b. Practicing crop rotation

- The practice of growing crops on piece of land by following a definite order.
- It improves soil fertility in the following ways
  - Controls specific soil-borne pest6s and diseases
  - Ensure maximum utilization of soil minerals from all horizons
  - Legumes include in the cycle add nitrates through nitrogen fixation
  - Controls specific crops weeds such as witch weed(kaufiti) (strigga spp)

c. Regulation of soil Ph

- Soil ph is the degree of acidity or alkalinity of the soil solution.ph can be regulated by;
  - Use of organic manure
  - Se of acidic fertilizers
  - Use of agricultural lime
- Goo soil pH has the following benefits
  - ensure availability of crop nutrients
  - increase the population and activity of soil organism
  - determines the type of crop to be grown

d. controlling soil erosion

- by doing the following ;
  - mulching
  - growing cover crops
  - strip cropping
  - contour farming
  - terracing
  - use of cut off drains

e. ensure proper drainage

- water-logging is not suitable for crop production apart from paddy rice and coco yams
- ways of dealing with water-logging;
  - draining excess water
  - application of organic manure
  - Breaking hard pans if present.

f. Timely weed control

- Weeds compete with cultivated crops for various resources like air, mineral and space and weeds should control before serious damage is done.
- Some methods of can be put into five categories namely.
  - Legislative
  - Cultural
  - Mechanical
  - Biological
  - Chemical

g. Practicing minimum tillage

- Over cultivation destroys the soil structure and farmers should therefore reduce4 the tillage operations as much as possible.
- Minimum tillage improves soil fertility in the following ways
  - Maintains the soil structure
  - Controls the soil moisture
  - Reduces the roots damage and disturbances
  - Reduce soil erosion since soil in intact

h. Practicing intercropping

- This is the practice of growing different s on the same piece of land at the same time.
- This improves soil fertility in the following ways

- Ensuring maximum utilization of the soil minerals
- Legumes included add nitrates through nitrogen fixation
- Proving better ground cove hence controlling soil erosion and smothering weeds.

Classification of fertilizers

- There are classified into two categories
  - Organic fertilizers
  - Inorganic fertilizers

1. Organic fertilizers (manure)

- They are prepared form plants remains and animal.

Characteristics of organic fertilizers

- They have low nutrients value per unit volume
- They release nutrients very slowly
- They are rich in many plant nutrients
- They are bulky and hence cumbersome to transport and apply
- They have few negative effects if used over a long period of time.

Classification of organic fertilizers

- They are three
  - Green manure
  - Farm yard manure
  - Compost manure

i. Green manure

- They are made from plants green plants and these plants are grown solely to improve soil fertility by incorporating them into soil.
- Crops used in making green manure include: maize, sorghum, wild sunflower, beans, clover and Lucerne.
- They are allowed to grow up to flowering stage, then ploughed back into the soil and allowed to decompose.

Qualities of crops to be used as green manure

- They should be able grow rapidly
- They should be highly leafy or vegetative
- They should be capable of fast decomposition
- They should be short for ease of ploughing into the soil
- They should have the ability to grow on poor soils.

Reasons why green manure is not commonly used

- Proper timing of the correct stage for ploughing into soil necessary
- There is inadequate land spaces to grow the green mature crops
- There of nutrients by green manure crops is slow. Thus, it takes a long time to completely decompose and release nutrients for crop use.
- Most of the green manure crops are food crops therefore farmers are unwilling to destroy them especially where land is limited

- They absorb available soil moisture and nutrients at the expense of incoming crops.

ii. Farm yard manure (FYM)

- It is also called *muck or pen manure.*
- It is a mixture of animal wastes and animal bedding which are completely rotten.

Preparation of farmyard manure

Procedure

Animal wastes and bedding are taken from the animal's house yard (yard) and are then heaped under rain-proof sheds where they are left decompose. Constant turning-over or mixing is done to ensure uniform decomposition. Water may also be sprinkled if dry to speed up decomposition by the micro-organism.

- When completely decomposed it is dry and not completely decomposed should not be used because it may cause fungal disease.
- Fresh animal waste should not be used because bacterial available here fix nutrient s making them unavailable for plants.
- When farm yard manure is exposed to open,, there is loss of nutrients due to;
  - Volatilization of nitrates(its conversion into ammonia gas)
  - Leaching and washing away by rainfall
- It is therefore important to prepare manure under shed.

Factors that affect nutritional value and quality of farmyard manure

a. **The type of animal producing the manure**:
- different animals produce provide varying qualities of farm yard manure depending on their nutrition and nutrients requirements
- below is the order of nutrients richness of various animals manure from the highest to lowest
  - **i. poultry manure**
  - **ii. sheep manure**
  - **iii. pig manure**
  - **iv. horse manure**
  - **v. cattle manure**

b. the quality of feed given to animals
- for instance , livestock fed on feeds rich in nutrients will results in farm yard manure rich in the same nutrients

c. type of litter
- Litter with high level of nutrients produces high quality manure.

d. method of storage
- Proper storage is necessary to prevent volatilization, washing of nutrients by rains and leaching.

e. age of the manure
- well rotten manure is rich in nutrients and release them fast into the soil

f. age of the animal
- Young animals produce inferior quality manure while older animals give high quality manure. This is because young animals use most of the nutrients for growth.

Advantages of farmyard manure

- It is cheaper than the commercial fertilizers
- It does not require high technical skills to make
- It use the locally available material and therefore minimizes the wastage while maximizing utilization of the resources
- It improve soil structure
- It is cheaper way of cleaning the environment. That is scattering of litters and animal waste is avoided

Disadvantages

- It is bulky, hence difficult to prepare, transport and apply
- It release nutrients slowly
- If poorly stored, soluble nutrients are easily leached and volatilization can take place
- If used before it is completely rotten, it can cause fungal infection or scotch the plants
- It can introduce weeds in the seedbed through the litters infested with weeds seeds.

iii. Compost manure

- This is the manure prepared from organic, material like soft hedge cutting, grass and kitchen wastes.

How to prepare compost manure

- It is prepared by piling plants residues in a heap or pit. The materials should be turned over at regular intervals to facilitate uniform rate of decay. If the material is of low nitrogen content, ammonium sulphate may be added to improve the nitrogen content of manure. If the material is dry, it cab moistened by sprinkling water.

Advantages of compost manure

- One does not have to own livestock in order to prepare it
- A lot of manure can be produced within short time. however quantities depend on material available
- A variety of materials can be used in its preparation
- Use of organic manure improves soil aeration
- Locally available materials can be used making it cheaper than the artificial fertilisers
- It improves the soil structure

Disadvantages of compost manure

- It release nutrients slowly into the soil
- Large quantities of compost manure are required to supply enough plants nutrients
- It preparation is labor intensive
- It may induce soil-borne peats, such as nematode

Advantages of organic fertilizers

- They are cheap because they are made from locally available materials
- They bind the soil particles together thus improving soil structure
- They improve water holding capacity of the soil

- They supply a variety of essential nutrients
- They have a long residue effect, they can supply nutrients for a long period after application
- They encourage activities of soil micro-organisms because they provide food and shelter to the organisms.
- They help to buffer(control or cushion) soil PH
- They help to moderate soil temperature
- They do not require special skills to prepare or apply

Disadvantages of organic fertilizers

- They are bulky, hence expensive to transport and apply
- They have low nutrient per unit weight
- They take time to release nutrients as they must undergo complete decomposition
- They can introduce weeds to the field
- They can cause fungal infection or scotch the plants if not well-decomposed
- They require a lot of labour to prepare.

2. Inorganic fertilizers

- Classification of inorganic fertilizers can be classified based on
  - Nutrients composition
  - Reaction with the soil

1. Nutrients composition

- Can be classified into two

a) Straight fertilizers

- *These contain only one of the three primary macro-nutrients*.
- Examples of primary macro-nutrients are nitrogen(N), phosphorus(P) or potassium(K)
- Categories of straight fertilisers are nitrogenous fertilisers, phophatic and potassic fertilizers.

b) Compound fertilizers

- These contain two or three of the primary macro nutrients

Types of compound fertilizers

- **Incomplete compound fertilizers:** contain only two primary elements e.g. Diammonum phosphate (DAP), contains 18-47-0, 20-20-0 and 23:21:0
- **Complete compound fertilizers:** contains all the three primary elements (N, P, K) **e.g.** 20-10-10, 17-17-17, 15-15-15 and 2:18:15.

2. Reaction with the soil

- They can either be
  - **Acidic fertilizers:** are those which increase the acidity (lower soil pH) of the soil. e.g. Sulphate of Ammonium
  - **Basic fertilizers:** are those which reduce the acidity (raise soil pH) of the soil.
  - **Neutral fertilisers:** neither raise nor lower soil pH; they do not affects the acidity of the soil

Identification properties of inorganic fertilsers

1) Straight fertilsers

a. Nitrogenous fertilizers

- Have the following properties
  - Readily soluble in water
  - Short residual effects on the soil
  - Scotch or burn plants body upon contact
  - Highly volatile when applied to dry soil like sulphate of ammonia
  - They are highly reached especially when rainfall is heavy and therefore application should be done when root are fully developed.
  - They are hygroscopic meaning have a tendency to absorb moisture from atmosphere and stick together like a cake. Therefore should be stored under dry condition for shorter periods.

Application of excess nitrogen fertilizers may have the following adverse consequences

- An increased incidence of certain leaf disease such as in rice blast
- Poor malting in barley
- Poor combustibility in tobacco
- Lodging of cereals crops
- Excessive vegetative growth at the expense of tuber formation in root crops
- Failure to from tubers in roots crops. For example, Irish potatoes.

Examples of nitrogenous fertilisers

- **Sulphate of ammonia** (SA) which has 21% nitrogen and 26% sulphur
- **Ammonium nitrate** (AN) contains about 34-35% Nitrogen in ammonium and nitrate forms
- **Ammonium sulphate nitrate** contains 26% nitrogen and 13% sulphur
- **Calcium ammonium nitrate (**also referred to as nitro chalk) consist of ammonium nitrate ad calcium carbonate. It has 21% and 10-20% quick lime
- **Urea** has 45-48% nitrogen all in ammonium from, its granular are white

b. Phosphatic fertilisers

- Most soils contain large amounts of phosphorus though much of it is available in the form which not absorbable by plants. Phosphorous form insoluble compound with other soil minerals.

Properties Phosphatic fertilsers

- They are not readily leached
- Slightly soluble in water
- In acidic soils, much of the fertilsers is converted into insoluble compounds and thus becomes fixed. Due to this fixation, phosphate fertilizers must be placed in the root range of growing crops. For example, by drilling or mixing with the soil in the planting holes
- Have along residual effect on soil and can be available to plants along after its application (in some case up to 4 years)
- Have slight scorching effect unlike nitrogenous and potassic fertilsers

Examples of phosphatic fertilizers

- **Single super phosphate fertilisers** (S.S.P) contains 18-21% $\mathbf{P_2O_5}$ and sulphur which distinguishes it from double or triple phosphate.
- **Double and triple super phosphate (D.S.P or T.S.P)** usually granular are grey. They contain about 40-49% $\mathbf{P_2O_5}$
- **Soda phosphate** contains up to 20% $\mathbf{P_2O_5}$(**phophorus pentoxide**) and many other elements for example 30% CaO, 30% F_eO and small elements like Mg, Cu, Zn, CO, MO and B. it is good for soil lacking trace elements. it is grey and powdery
- **Basic slag** it contains 15-16 $\mathbf{P_2O_5}$ and 40-50 lime. It is suitable for heavily acidic soils such as sand. It also contains trace elements like S, Mn, Mg,Cu, CO,and MO. It is highly basic and should not be mixed with other fertilsers. it grey and powdery

c. Potassic fertilizers

- Have moderate scotching effects and are fairly soluble than phosphate and less than nitrogenous fertilsers.
- Sources include: crude slays, sea weeds, wood ashes and potassium containing rock.
- It can also be produced as by product cement making. Should be applied only if soil test show deficiency of potassium.

Examples of potassic fertilsers

- **Muriate of potash (**potassium chloride**)** : it is whitish –red
- **Potassium sulphate (**sulphate of potash)
- **Wood ashes**

2) Compound fertilsers

Examples of compound fertilisers

- 17-17-17
- 11-54-0
- 15-50-0
- 15-45-0
- 6:18:6 (compound S)
- Diammonum phosphate (DAP0. It is grey in colour and granular in form. It has a fetilse4r grade of 18-47-0 and usually applied at planting time. It has acid inducing effects.
- 23:21:0
- 2:18:15(compound A)
- 4:18:15 (compound B)
- 8:18:6 (compound D)

Advantages of compound fertilizers

- They are cheaper and more convenient to apply thereby saving on cost, time and labour
- They are easy to store as they do not form lumps when stored for a long period of time

Disadvantages of compound fertilsers

- They can be uneconomical considering that their nitrogen component may not be utilized where the plants roots are not developed at the time of fertilsers application
- They are expensive to buy

Advantages of inorganic fertilisers

- They are less buck hence cheap to apply and transport
- They can contain high level of nutrients per unit weight
- They readily releases nutrients once applied

Disadvantages of inorganic fertilizer

- They are expensive to buy
- They only supply particular nutrients
- They have a short residual(remaining or enduring) effects
- They require special skills to store and handle
- They may alter soil pH id applied for a long time
- May be harmful to crops if applied in excess
- Some may inhibit the activities of some micro organisms

Difference between organic and inorganic fertilsers

Organic fertilsers	**Inorganic fertilsers s**
• They originate from plant and animals remains	• They are artificially prepared
• They have low levels of nutrients per unit weight	• They have high level of nutrients per unit weight
• They releaser nutrients slowly as they require time to decompose	• They readily release the nutrients for plants use
• They are bulky, hence difficult to transport, store and apply	• They are less bulky hence easy to transport, store and apply
• They help to moderate the soil temperature	• They have no effects on soil temperature
• Increase microbial activity as they serve as shelter and food for micro-organisms	• They may inhibit the activities of soil organism
• They buffer soil ph	• They may increase or decrease the soil pH depending on their pH
• They improve the soil structure as humus bind soil particles together	• Most of them have no effect on soil structure except those with liming effects
• They are not easily leached as nutrients are released slowly	• They are readily leached especially those that are highly soluble in water
• They can be applied in any quantities without risk of crop damage	• Excess may be injurious to crops
• Some could be a source of crop pests and disease	• They are not possible source of pests and diseases
• Some may be a source of weed seeds	• They are not possible source of weed
• Some may cause tainting of pasture	• They do not taint pasture

UNIT 3: AGRICULTURE AND CLIMATE CHANGE

- Climate refers to all weather elements of an area observed over a long period of time usually 30 years. such elements of weather include the following
    - Rainfall/precipitation
    - Temperature
    - Wind
    - Relative humidity
    - light

- **Climate change:** is the gradual change in the weather elements of a particular place.

Causes of climate change

- Factors that lead to climate change have been put into two groups
    - Natural processes
    - Human activities

a. Natural causes

- The earth's climate can be influenced by natural factors outside climate systems. such factors include;
    - Volcanic eruptions
    - Change in earth's orbit around the sun
    - Change in solar radiation
- These natural factors have very little significance in climate change

b. Human causes

I. Production of green house gases (GHG's. these are gases such as carbon dioxide, methane, nitrous oxide and fluorocarbons. They raise the global temperature by absorbing reflected heat from the earth.

II. Aerosols. Absorb solar and infrared radiations hence raising the global temperature

- **Ways in which aerosols are released into atmosphere**
    - Dust released into the atmosphere by tilling land when very dry
    - Burning of biomass lead to production of soot particles
    - Industrials process produce a variety of aerosol
    - Exhaust fumes from engine also produce aerosol

III. **Deforestation: this** is the indiscriminate clearing of forest cover which leads to change of land surface and this leads to changes in the amount of light reflected from the earth's surface back to apses.

Effects of climate change

- Climate change impacts agriculture and people livelihoods in different ways

a. **Impact on land**
    - Erratic rainfall due to indiscriminate deforestation
    - Seasonal droughts that gradually give way to acidity leading to loss of arable land
    - Floods which lead to serious land degradation by forming of large gullies and consequent loss of arable land
    - Changing woodlands. Here due to changing temperatures, trees adapted to a particular temperature, as the condition changes, the habitat becomes unsuitable for the trees
    - Landslides and mudslide degrade the land for agricultural activities

b. **Impact on crops**
    - Increase in crops pest due to increase in temperature which favors theirmultp0lication and this lowers crops yield.

- High carbon dioxide stimulate the growth of certain plants and increasing crop yield but of low quality
- Erratic rainfall and drought lead to total crop failure lowering the expected yield.
- Strong winds cause breakages of trees crops and lodging of annual crops affecting the expected yield.
- Landslide and mudslide may destroy crops already growing in field.
- Increased hailstorms may cause serious damage to crops in the field, such as tea, lowering the output of the crops.
- Flash floods and intense rainfall lead to loss of fertile soil. This reduces the potential of the land to reduce high crop yield.
- Unpredictable weather patterns leave the farmers unable to make appropriate decisions such as time for land preparation and time for planting annual crops. Early or delayed planting considerably lowers the expected yields.

c. **Impacts on livestock**

- Increases in temperature ,may induce heat stress in animals in areas that were initially cooler
- Low rainfall and drought ill lead to quantity of fodder for livestock lowering livestock growth and output
- Increase in temperature lead to faster multiplication and growth of livestock parasites such as ticks and tsetse flies. This subsequently lead to increase vector-borne diseases negatively affecting the livestock industry
- Low levels of water lead to low fish stock. Some water-bodies even dry completely, such as lake chilwa in1995, resulting in total loss of biodiversity. Some of which are endemic to Malawi.
- Temperature changes will influence the distribution of livestock as areas that were previously cool become warmer with time.

d. **Impact on livelihood**

- Increased food insecurity which leads to malnutrition and hunger. This results in reduced farm labour and chronic food deficits
- Floods lead to water pollution lowering the quantity of pure water. This may result in outbreaks of water borne disease such as dysentery and cholera
- Low water levels in rivers and damages have impact people negatively on hydroelectric power generation such as Shire River. This forces people to use alternative source of fuel such as biomass leading to further deforestation
- Spread of malaria and other vector-borne diseases in areas previously cold for vector to survive
- Flood lead to siltation of dams and other water bodies lowering the capacity for storing water. The floods may also damage water pipes compounding the problem of clean water shortage
- Low water supply impacts negatively on industries as they do not get adequate water. This may lead to loss of highly needed employment for sustainable livelihood
- Floods are responsible for the destruction of fish ponds leading to loss of livelihoods for the fish farmers
- Forest fires are most prevalent during dry season. Such fires lead to loss of seedling and biodiversity of given region
- In the rural communities, drought means women have to travel long distances in search of water for domestic use. This translate to less meaningful work done in the crops fields bearing in mind the women are the major providers of labour in small scale farming.

UNIT 4: IRRIGATION

- Irrigation: is the artificial application of the water into the soil so as to provide adequate moisture for plant growth.
- It is practiced mainly in areas where rainfall is inadequate or unreliable.

Importance of irrigation

- It enables growing crops during dry seasons when there is no rain
- it use to supplements inadequate rainfall so as grown crops
- it is a method of land reclamation in arid and semi areas
- it enables growing of crops in special structures such as green houses
- it enables one to grow crops that require high amounts of water such as paddy rice
- it is a source of employment where it used intensively
- it promotes crop production for export market earnings revenue to the country
- Overhead irrigation helps control some crops pests such as aphids.

Systems of irrigation

- There are three systems and these are
    - Surface
    - Overhead
    - Drip

a. Surface irrigation

- Water reaches fields to be irrigated through canals or furrows.

Conditions necessary for surface irrigation

i. **Topography:** land must be fairly level (gentle slope) for water to flow by gravity.
ii. **Amount of water supply:** plenty of water is required due to high wastage through seepage and evaporation.
iii. **Soil type:** the soil must be able to hold water for long period of time and should be preferably be clay soil.

Types of surface irrigation system

- Flood irrigation
- Furrow irrigation
- Basin irrigation

a. Flood **irrigation**

- Water is allowed to flow into the field through furrows or canals. It is then directed to various parts of the farm by opening sluice gates in the field.
- Requires land be as near flat as possible.
- It is best for growing paddy rice which requires flooded field.

Advantages of flood irrigation

- It is relatively cheap to establish
- It requires less skill

Disadvantages of flood irrigation

- A lot of water is used
- Water in unevenly distributed causing water-logging in some areas while other parts do not get enough water.
- Siltation of canals is prevalent
- It can only be practiced in soils with high water retention capacity
- It can only be practiced on flat land.

b. Furrow irrigation

- Use on land with gentle slope of 1% gradient .water flows through the open gates to furrows. Crops are planted on the ridge of the furrows. The spacing of the furrows depends on the spacing of the crops,

Advantages of furrow irrigation

- Reduces incidence of fungal diseases such as leaf blight, because the leaves do not come into contact with water.
- Relatively cheap to establish and maintain
- Requires less skills

Disadvantages of furrow irrigation

- A lot of water is wasted
- Soil erosion may occur if the design is not well done
- If water is saline, it may affects plants roots
- It is not easy to maintain a uniform flow of water in the furrows from the source to the end.

c. Basin irrigation.

- It is the flooding of the entire are enclosed by earth embankment known as dykes
- The entire area is flooded by opening a dyke and later on closing it, water will remain in the basin.
- Raised ground is made around each plant known as dyeke or basin. Water is allows into each level basin through an inlet. Fruits trees can be grown under this system and a basin is created around each tree.
- The difference between flood irrigation and basin irrigation is that, in flood irrigation the surface is always flooded with water while in basin, water is only allowed to flow in when needed.

Maintenance of surface irrigation

- The following maintenance operations are necessary
  - Repair of levees if broken
  - Removal of weeds in the canals, basin inlet and outlet
  - De-silting of canals
  - Repair of sluice gates

Advantages of surface irrigation

- It is cheap to establish and maintain
- It does not require a lot of skills

Disadvantages

- It results in accumulation of a lot of salts in the soil
- It cannot be used in sloppy areas
- Floods may destroys basins during heavy rains
- A lot of water is wasted
- There may be high incidence of water borne diseases such as bilharzias and malaria

b. Overhead irrigation

- This is a means of supplying water to growing crops from above in form of fine droplets.
- It can be practiced in three ways
  - **i. Use of horse pipes:** this is also appropriate for small scale farmers
  - **ii. Use of sprinklers:** this is where the water if forced through the pipes and out through the sprinklers. The water must be under high pressure for the system to work effectively.
  - iii. **Use of watering cans:** suitable for watering seedlings in a nursery bed but only on small scale.

Overhead irrigation using sprinklers

- The system is made up of the following components;
  - A water pump
  - Main pipes
  - Lateral pipes
  - Riser pipes
  - Sprinklers
- Irrigation pipes are mostly made of aluminium

a. Pump

- Provide a mechanical force that pushes water through the pipes and out through the sprinkler
- Types of pumps
  - Hydraulic pump
  - Reciprocating pump
  - Centrifugal pumps
- Pumps could use electricity, petroleum products or animals as source of power or be connected to the tractor power take off shaft.

b. Main pipes

- This delivers water from pumps into the field. The pipes could be buried or laid on the surface like that of aluminum if main line is portable.

c. Laterals pipes

- Connected to main pipes at a definite intervals and the bore is narrow as compared to main pipes so as to sustain high water pressure.

d. Riser pipes

- They are vertical to the ground and are fitted at a definite intervals from lateral pipes
- They hold the sprinklers at the top.

e. Sprinklers

- Release water under pressure in form of fine droplets
- They are two types of sprinklers
  - **Continuous rotating sprinklers;** appropriate for small scale farming
  - **Spring loaded sprinklers**; suitable for scale irrigation

- Sprinklers are arranged in such a way that the circle irrigated by individuals sprinklers overlap. This ensures that there are no spots left unirrigated.

The period of time the sprinkler remains in operation in one point depends on:

- Soil type
- Crop being irrigated
- Topography
- Soil moisture content.

- **The working pressure should be suitable for the crops beings. For instance;**
  - Low pressure for vegetables crops
  - Medium for fields crops
  - High pressure for perennial crops such as coffee

Advantages of overhead irrigation

- Does not require leveling of the land, can be practiced even on sloppy areas.
- Water is evenly distributed in the required areas
- The method is most ideals for sandy soil
- It is water economical compared to surface irrigation
- Soluble fertilizers and herbicides can be mixed with the irrigation water and applied so
- It is e4asy to move the sprinkler from one point to another.
- Soiler4soin is minimized
- It does not require special skills

Disadvantages

- It is expensive to start
- May destroy the soil structure due to impact of water drops
- The method may require the establishment of wind breaks
- It increases incidence of fungal diseases on the crops
- It can lead to soil erosion if not well controlled
- The water must be under pressure
- The water must be free from solid impurities otherwise the sprinklers nozzles will be blocked.

c. Drip irrigation

- In this system water is supplied to the roots of crops in form of drops. It is also called trickle irrigation. Polythene pipes with nozzles at specific intervals are used to deliver the water to the crops.

How drip irrigation works

- Water is supplied at the base of crops by drop by drop
- The system is made up of series of pipes with nozzles at specific intervals
- Pipes are made of plastic and laid along the crop rows
- The nozzles allow water to flow out drop by drop, through the speed varies
- Some nozzles are able to trap and hold any solid particles that may be in the water thus, preventing blockage of nozzles
- The distance from the nozzle to the other depends on the spacing of the crops to be irrigated.

Advantages of drip irrigation

- It use water economically, hence suitable for dry areas
- Does not encourage fungal disease on the crops
- Does not encourage growth of weeds between rows
- Water even at low pressure can still be sued.

Disadvantages

- It is quite expensive to install
- It requires high levels of skills
- The water must be free from solid impurities to prevent blockage of nozzles

Factors that influence the and time of irrigation

- **Type of soil:** soil with high drainage like sandy soil requires to be irrigated more frequently compared with low drainage like clay soils.
- **Type of crops:** crops that require more water like paddy rice should be irrigated more frequently and for longer duration.
- **Weather conditions:** hot and dry weather require more water that cool weather due to evapotranspiration.
- **Moisture content of the soil:** if an area has recently received rainfall, the soil is still having some moisture and only small amount of water will be required if one is to irrigate that area
- **Presence of mulch:** mulching conserves soil moisture by reducing its rate of evaporation. This call for low frequency of watering the crops
- **Stage of plant growth:** some crops require more water in a certain stages of their crop than other stages. Maize requires more water during the silking and filling stages of its growth and hence high frequency of watering.

How to irrigate vegetables in a school garden

- **Step 1:** decide on the type of irrigation to use. This may be influenced by the ;
    - Type of crop to be irrigated. Sprinklers not suitable for crops like tomatoes that are prone to fungal diseases.
    - Available capital. some methods are very expensive to use
    - Skills available.
- **Step 2:** gather the required equipment's such as hoes pipe, watering can and sprinkler.
- **Step 3:** irrigate the crops as follows;

a. Using a horse pipe.

- Connect to one end of the hose pipe to water tap.
- Open the water tap for water out through the pipe
- Hold the other end of the horse pipe
- Direct the horse to the crop to be irrigated
- Create pressure by partially blocking the opening of the hose pipe for water to reach the crops that are distance way.
- Ensure crops get adequate water

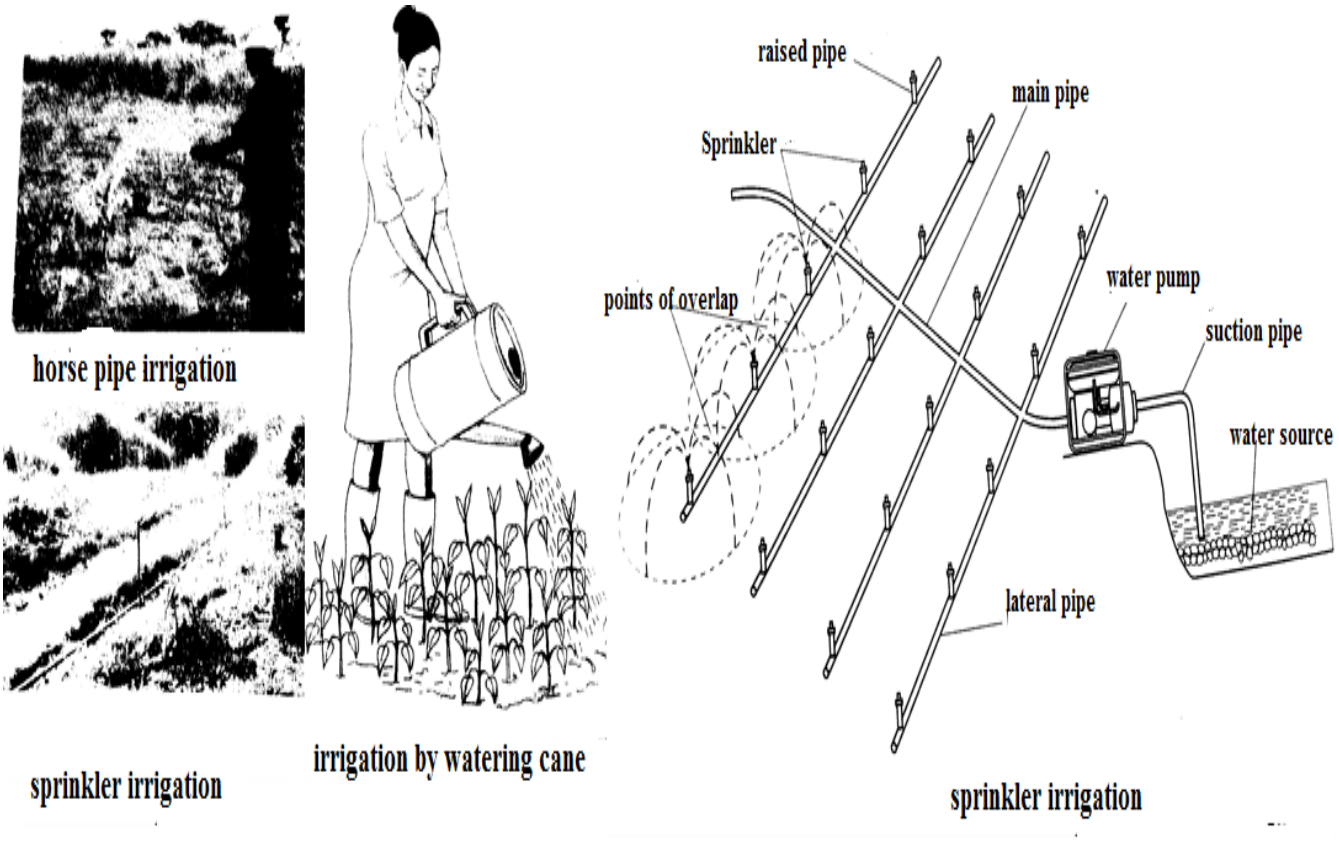
b. Using a watering can

- Fetch water into the watering can
- Carry the water to the vegetable garden

- Apply water to the crops by slanting the can for water to come out through the nose
- Ensure all crops get adequate water.

c. Using hose pipe and sprinkler

- Connect one end of the hose pipe to a water tap
- Connect a sprinkler to the end of the pipe
- Place the sprinkler to the end of the pipe
- Place the sprinkler in appropriate position in the garden
- Open the tap for water to flow through the pipe and out through the sprinkler
- Check that the crops have received adequate water
- Shift that the crops have received adequate water
- Shift the sprinkler to another position so as to water other crops
- The position of the sprinkler is such as that of circular areas irrigated should overlap to ensure that no crop is left unwatered.



types of overhead irrigation system

Factors to consider when selecting an irrigation system

i. **Topography:** surface requires relatively flat areas where water can flow slowly with little erosion and piped irrigation can be practiced on any topography.

ii. **Source of water:** source of must be reliable other systems require more water than the other like surface than piped irrigation.

iii. **Type of crops:** paddy rice can be grown under flood irrigation because it require that field remains covered by water and crops prone to fungal disease overhead irrigation be avoided at all cost.

iv. **Value of crops:** some irrigation systems are very expensive to stall, for example irrigations. The farmer should only drip irrigation if the crop has high profit margin. it would uneconomical to grow maize under drip irrigation

v. **Capital:** a farmer should choose a system that can manage like surface irrigation than drip irrigation which is very expensive to install.

vi. **Technical knowhow:** skills required and tecnoopl0ogicaladvance also influence the system of irrigation to use as such systems require high technological knowledge compared to surface irrigation

Establishment of an irrigation unit

- An irrigation unit is a set up that provide water to crops automatically. The set-up could be for drip irrigation or sprinkler.

Requirements

1. A timer that could battery operated
2. Pressure regulator
3. Garden hose of appropriate length
4. Hose thread adaptors
5. Main drips lines a quarter inch plastic tubing
6. Assortment of connector T-shaped, L-shaped and below joins
7. Emitter lines1/8 plastic tubing
8. Emitters
9. Tape measure

Procedure

1. Determine the water source, either a tank or outdoor faucet
2. Lay the main drip lines and the emitter line under the sun to soften the plastic, so that it easily works with
3. Fix the emitter or nozzles at appropriate intervals, according to the crops spacing along the emitter lines
4. Have enough emitter lines for all the crops in the filed
5. Cut the main line with a pair of scissors and push the ends in the T-shaped connectors.
6. Connect each emitter line to a T-shaped connector already fitted on the main line
7. Connect the timer to the tap of water tank followed by hose thread adaptor, garden hose and another hose threads adaptor.
8. Connect the main drip irrigation line to the final hose thread adaptor.
9. Set timer on manual and then set it on, turn on the tap.
10. Water will be seen spouting from the emitters, adjust the amount of water flowing using the tap.
11. Check for leakages along the whole unit, and if any seal them appropriately
12. Set the timer, time duration for watering the type of crop to be irrigated and also the amount of moisture already in the soil.

Maintaining irrigation unit

- This depends on the system being practiced , whether surface or piped irrigation

a. **Surface irrigation**:

- it can be maintained in the following ways;
  - repairing levels of if broken
  - removal of weed in the canal, basins inlet and outlet
  - de-silting
  - repairing of sluice gates

b. **piped irrigation**

- it can be maintained by following ways
  - repairing broken components such as pumps
  - replacing broken pipes, sprinklers among others
  - occasionally flush they pipes with phosphoric acids to remove salts especially where saline water is used
  - replacing faulty parts such as emitters or nozzles
  - unlock the sprinkler nozzles in case they are blocked

UNIT 5: EXPERIMENTAL DESIGNS

- Experimentation is a type of research design that deliberately imposes the treatments on a group of objects or subjects with interest of the observing their response
- It defers from observation study where data is collect5ed and analyzed without changing the existing conditions. In experiments all; factors are held constant except the treatment that is the independent variable.
- Experiment is carried out in controlled setting
- **Experimental design:** is the way of in which a particular experiment is planned out. Good experimental designs should give reliable results

Types of experimental designs

- Randomized block design
- Latin square design

a. Randomized block design

- Blocking is the practice of placing similar test objects together
- The block are vertical columns and it is homogenous
- All treatments are placed in each block
- Treatments are written at manner
- The number of treatments is not equal to number of blocks

Example of randomized block design

blcok / **plot**	**Block 1**	**Block 2**	**Block 3**
Plot 1	**Sc42**	**SC40**	**SC10**
Plot 2	**SC40**	**SC10**	**SC45**
Plot 3	**SC10**	**SC45**	**SC42**
Plot 4	**SC45**	**SC42**	**SC40**

b. Latin square design

- It can be seen as a square, with rows and columns to from blocks
- Number of treatment is equal to number of blocks.

Example

Block/plot	Block 1	Block 2	Block 3
Plot 1	SC41	SC40	SC32
Plot 2	SC40	SC32	SC41
Plot 3	SC32	SC41	SC40

Factors to consider when laying out experiments

- **There are three factors**

a. **Treatment**
   - A treatment is anything a researcher is deliberately imposes on experimental units
   - Treatment are carried out with the aim of solving a hypothesis
   - **Control treatment:** the one which is familiar to the researcher and this one serve as **comparisons purpose with other treatments**

b. **Randomization**
   - Is the practice of assigning objects of study by chance in an experiment.
   - This assist in eliminating bias from the researchers.

c. Replication
   - Involves repetition of the basic experiment

Benefits of replication

- Secure more accurate estimates of the experimental error
- Decreases experimental errors thus increasing precision
- Obtains a more precise estimate of the mean effect of treatment

Ways of randomizing treatments

- There are different ways such as manual and automated

Manual methods of randomization include

- Shuffling of playing cards
- Drawing pieces of papers from a bag
- Throwing a dice
- Tossing a coin

a. Tossing a coin
   - Can be used if there are only two treatments since a coin has two sides.

b. Using a dice
   - Can be used if there are six treatments and each treatment is given a number from 1-6.
   - Then you throw a dice and the first appear you place in first plot in block 1, and you repeat with all treatments.
   - In case you get the same number you throw it again, until you get a different number.

c. Using piece of paper
   - Treatments are written on pieces of paper of the same size
   - Place them in a bag
   - Shake vigorously and you pick a paper without looking at them and place it in first plot block 1

d. Using random number table

- Number are written at random and they are generated by computers
- If there are 5 treatments, all numbers above five are eliminated
- Then you place treatments in blocks, by following their order.
- Note: don't change the order in which number appear in the tables but simply remove unnecessary numbers.

Conducting an agricultural research

- The following should be put into consideration
  - Applying treatments
  - Collecting data
  - Recording data
  - Analyzing data
  - Evaluating data

a. Applying treatments

- Treatments selected should be done randomly to avoid biasness

b. Collecting data

- Data is anything given as a fact on which research conclusion will be based.
- Tool in collecting data include
  - Observation
  - Questionnaires
  - Interviews
  - Document analysis
- when collecting data ensure the following
  - collecting accurate data
  - record the data in book to serve as reference
  - Use proper tools for carrying out measurements such as weight, height and length.

c. Recording data

- Data can be recorded in various ways. These are
  - Tables
  - Graphs
  - Figures

i. **Tables**

- A good table should have the following
  - Table number
  - Title
  - Columns
  - Row headings
  - Body of the table
  - Foot note

ii. **Graphs**

- These are used for illustrating trends and relationship among sets of variables. There are different types of graphs
  - **Line graphs** :show relationship among data
  - **Bars and histograms**: used to compare quantities
  - **Pie**: show proportions of whole component.

- **Flow chart**: show process of complex system

iii. **Figures**

- These are used to show vivid evidence of research findings
- They include drawings and photographs

d. Analyzing data

- It involves separation of data into constituent elements and evaluating it to distinguish its
- component elements separately or in ration to the whole data

Techniques of data analysis

- There are two techniques of analyzing quantitative data. These are
  - **Descriptive**
  - **Inferential**

a. Descriptive analysis

- Involves the use of;
  - **Central tendencies:** include mean, median and mode. It shows how close a measure is to the central measure.
  - **Dispersion:** such as range, quartile deviation and standard deviation, to describe a group of subjects. It shows how far the measure from central measure is.

b. Inferential analysis

- This is where the statistic is used to draw conclusions about population from which the sample was taken.

e. Evaluating data

- This is the discussion and describing the implication of the finding by interpreting the data. One should be able to state and explain how the study helps to resolve the original problem and suggest improvements.

Importance of report writing in agricultural research

- Provides means of presenting ones findings after the research is concluded and this makes the work available to other people to read
- Outline the significance of the findings
- Give recommendations, this is possible source of further research
- Allows other scientist to asses work and criticize it.
- Allows other scientist to replicates your work and either approve or disapprove it
- Are important to those who finance the research because it enables them to see what their money was put into.
- Can be used in decision and policy making with an aim of improving agricultural production.
- Reports provide reliable permanent information that can be available over a long period of time.

Format for report writing

- Title
- Introduction
- Aim
- Objectives
- Material and methods
- Design of the experiment

- Results
- Discussion of the results
- Conclusion
- Recommendation

i. Title

- Describes what is being investigated and give a summary of the main idea of the research in simplified and clear way.
- Example: "a report on the effects of planting dates on the yield of maize"

ii. Introduction

- It provides the basis of the study
- It gives an overview of the research, highlighting the background information, statement of the problem being analyzed, the significance and the scope of the research.

iii. Aim

- It gives the general intention of the research.
- Should be brief as possible.
- Example: the aim of the study is to explore the effects of varying depth on the total yield of maize using experimental design:

iv. Objectives

- These are specific aims of the study.
- Show specific outcomes that specify more directly what the research is going to do

A good objective should be;

- Specific
- Measurable
- Attainable
- Realistic
- Time bound
- Clearly indicates the variable to be investigated and their relationship such as
  - Determining the relationship between depth of planting maize seeds and the yields of maize Mzimba district in Malawi.

v. Materials and methods

- Indicates materials and equipment's that were used in carrying out the research such as hoes, machete
- It also outlines the procedure followed when carrying out the research.

vi. Design of the experiment

- This describe pattern used for conducting an experiment
- The researcher should
  - Identify and name the research design
  - Briefly and in concise terms, describe the design
  - Justify for the use of design
  - Explain how the design will be used.

vii. Results

- This give detailed description of the results obtained after data analysis
- Data collected cane be presented in tables and figures
- There are two types of data that can be collected
  a. **Quantitative data**: from measurable variable e.g. height of seedlings, size if the job, yield of maize per unit area
  b. **Qualitative data**: indicates the objects under study and individual differences that a researcher can find in a particular category.

- Data collected should be analysed using suitable techniques and presented in an acceptable and conventional manner

viii. Discussion of the results

- This involves the interpretation of the findings in the research objectives.
- The following procedure should be followed
  - Give a brief summary of the problem that was being investigated
  - Present the major findings under each objective
  - Discuss the possible reasons why the results occurred that way
  - Make theoretical interpretations of the findings

ix. Conclusion

- It shows a reasoned judgment of the issues raised in the research process. And should be based on the research problem and also on research objectives.

x. Recommendations

- These present the possible solutions to the research hypothesis based on the findings of the research. The recommendation should have a target group and suggest for further research in the same field.

UNIT 6: GENDER AND AGRICULTURAL PRODUCTION

- **Gender roles:** refers to the cultural or social duties, performed by either male or female members in the given community.
- Women constitute about 60 to 80% of the agricultural labour force

The following are roles performed by women

- Producing agricultural crops. Women do activities like weeding, harvesting, fertilizer application and other related duties
- Rearing livestock
- Processing and preparing food
- Working for wages in agricultural or other rural enterprises
- Collecting fuel and water
- Engaging in trade and marketing
- Caring for family members and maintain their homes

- **Participation of women in agricultural production is limited by the following**

i. Land ownership: land is owned by men and they have sole rights to decide on the proportion of what is to be produced as perceive by customary laws.

ii. Land use: men make decisions on growing cash crops while women are involved in production of food crops, but most activities are done by women .like panting, management practices, harvesting and storage, rearing livestock but selling is done by men.

iii. Access to credits: women have no right over land ownership and hence cannot use it as a form of security to get loans. These decisions on land acquisition are done by men.

iv. Extension and training services: they have limited access to extension and training service. This is due to socio-cultural values and low level of education.

v. Use of farm income: the decisions on how to use the income upon sales of the produce is left men.

Impact of gender roles in agricultural production

i. **Inappropriate land preparation:** over 70% of households in Malawi are headed by women and there is labor shortfall because of absence of male and this leads to inadequate and late land preparations.
ii. **Late planting:** late land preparation lead to late planting which affects general crops yields.
iii. **Low yields:** as a result of poor land preparation and late planting, crops yields will always be below average.
iv. **Low quality produce:** farmers do not practice timely pest control and disease control measure because of the pesticides may not be available at appropriate times.
v. **Low household income:** low agricultural outputs and low quality leads to low income to farmers
vi. **Low adoption of mechanized agriculture:** most farmers being of low levels o0f education have a hard time understand in modern technology. This therefore leads to efficient agricultural production.

Equal division of labor in agricultural development

- In Malawi, most labor on the farm is done by women and it is better when both men and women contribute equally toward agricultural production.
- This will promote agriculture in the fo9lliwng ways:
  - Men and women will be working as a team; hence decisions will be made jointly.
  - Men and women will cooperate in all farming activities
  - Work on the farm will be fairly distributed between men and women hence no overworking of one group.
  - Men and women will make consultative decisions in income utilization and investments

Role of women in making decisions in agricultural production

- Women are involved in making minor decisions in agricultural production and more often, in consultation with their husbands. Such decisions include
  - Time of land preparation
  - Time of planting
  - Time of crops weeding
  - Time of crop harvesting
  - Time of crop fertilizer application
  - Selling of minor produce like vegetable, fruits and small livestock like chicken and eggs.
  - What food crops to produce
  - How much food crops to produce?

Other decision made by women in consultation with their husbands includes:

- What commercial enterprise to undertake
- Marketing of major produce like tea and cotton
- Selling of livestock like cattle, pigs and goats
- How to produce, that is technology to use
- How much to produce, that is size of each enterprise.

UNIT 7: FARMING SYSTEM

- Farming system: refer to the way farmer organize and carries out farming activities on his or her farm.
- **They are two farming system**
    a. Intensive
    b. Extensive

1. Intensive system

- Farming system that is characterized by high capital investment and maximum utilization of available land.

Examples of intensive farming

- Mixed farming
- Mixed cropping
- Zero grazing
- Deep litter poultry rearing systems
- Battery cage poultry
- No-till cropping

a. Mixed farming

- This involves growing of crops and rearing of live stocks on the same piece of land

Advantages

- Animals can be used a source of farm power
- There is mutual between the crops and live stocks that, livestock produce manure for crops and crops remains are as live stocks feed
- There is diversification hence security
- There i9s maximum utility of land
- Animals waste can be used to produce biogas

Disadvantages

- Requires a lot of labor
- Requires high level of management skills
- Requires high capital investments
- Livestock may damage crops if not well confirmed

b. Mixed cropping

- This is the growing of crops on the same field. For details refer to form three notes

c. Zero grazing

- Animals do not directly feed on the pasture in the fields but are confined in she or yard where they are fed. (Details read pasture book 4).

d. Deep litter system

- This is the method of rearing poultry where birds are confined within a big house.
- Usually the house has no partition and the floor is covered by absorbent litter, it also has feeder, waters, laying nests and other equipments.

e. Batter cage system

- Birds are confined in wired cages. the number per cage varies from 1-4 depending on
    i. Size of cage
    ii. Size of birds
    iii. Environment
    iv. Farmer's preference
- Cages are in rows called tiers
- It has sloping floor to allow easy rolling of eggs to the collecting tray
- There is watering and feeding system which is continuous throughout the cages.

- A suitable cage for hens should be 1.4 ft high at the back, 1.8ft high in front, 1.5ft deep and 1.2ft wide.

f. No-till cropping(zero tillage)

- Crops are planted season after season without any tillage.
- Weeds are controlled by
  - Heavily mulching the crops
  - Alternatively herbicides
- Seeds are planted by drilling into the soil

Advantages

- Reduce soil erosion through the mulch which hold water
- Reduce the cost of crop production
- Conserve soil moisture
- Maintains soil structure
- Promotes timely planting
- Prevents root damage of cultivates crops

Disadvantages

- May encourage build-up of soil borne diseases and pests
- May lead to poor water infiltration
- May lead to poor aeration

Importance of intensive farming

- There is maximum utilization of available land, hence higher output per unit areas to support the growing population.
- Lead to high yields of good quality due to high levels of, management of skills and use of modern technology. This provides food for the growing population
- Intensive farming can be practiced in densely populated areas hence most appropriate in a country where population is growing fast.
- Intensive farming protects the environments because it reduces the amount of land used for agriculture which is in turn exposed to erosive. Therefore intensive farming ensures sustainable agriculture for future generation.
- Intensive farming results in high income per unit hence providing employment to the increasing force.

Extensive farming system

- This is farming system that is characterized by low capital investments and is usually carried out on large tracts of land.

Methods of extensive farming system

- Shifting cultivation
- Ranching
- Bush fallowing
- Cut and carry(visoso or chitemere)

a. Shifting cultivation

- Involves ploughing a piece of land and growing crops on it until the soil is exhausted. A Farmer then moves to an uncleared land and begins the process once again.

Advantages

- Land is given time to rest and regain its fertility
- Pest and diseases die upon shifting
- The cost of production is low because no fertilizer is used

Disadvantages

- It can only practiced in areas with large tract of land
- Its continuous use of the land may lead to soil erosion
- It can only be used for growing annual; crops and not perennial; ones.
- It may lead to land fragmentation

b. Ranching

- This is method of rearing livestock in vast land. The animals, usually beef cattle, are kept in portioned pasture known and paddocks.

Advantages

- There is maximum use of available pasture
- Pasture is given time to regenerate
- It allows the farmer time carry out management practices on pastures such as top-dressing, topping and re-seeding.

Disadvantages

- It requires large tracts of land
- It has low output

c. Bush fallowing

- This is a lots known as slash and burn agriculture. It is practice of clearing small plots of land to cultivate for a few years (generally 2 to 5 years) and then leaving the land under natural vegetation for much longer periods usually more than then 5 years to restore fertility.(for details refer to book 3 cropping systems).

d. Cut and carry(visoso or chitemere)

- In this method, crop residues and any forage are cut and carried from communal areas, or other farms and taken to the fields to feed tethered animals. (Details read pasture book 4).

Importance of extensive farming

- It is cheap due to low capital input
- It requires less labor inputs
- It ensures proper utilization of marginal areas which could not have otherwise been utilized.
- It does not require a high level of management of skills.

UNIT 8: FINANCING AGRICULTURAL ENTERPRISE

- **Sources of finance for agricultural production**
  - These include
    - Credit facilities
    - Personal savings
    - Inheritance
    - Grants or donations

a. Credit facilities

- Farmers can borrow capital as either cash or in kind(that is form of farm inputs)
- Credit may be obtained from these financial service providers

i. Commercial banks:

- The credit id payable with interest and it varies from one bank to another.
- Banks however they demand security inform of buildings or land title deeds. Most farmers in Malawi they borrow from banks as they fear indebtedness

ii. Non-bank formal service providers

- These include insurance companies, pension companies, Malawi stock exchange (MSE) among others
- They offer credit for farmers, although not very popular

iii. Micro-finance providers

- These include the financial cooperatives, SACCO and micro finance institutions
- These finance provides work under the Malawi Union Of Savings And Credit Cooperative (MUSCO) and Malawi microfinance network(MAMN)
- The MUSCO and MAMN coordinate and organize the exchange of information and farm inputs to farmers.

iv. Informal providers

- These rotating savings and credit associations, village savings and loans association or individual money lenders(also known as katapila)
- These are most utilized finance in rural areas
- These katapilas provide short terms loans at a short notice with relatively high interest without necessarily requiring security or collateral. The loans are payable in one to months and are repaid in a single installment.

Types of credit

- Can be categorized into two
  - Repayment period
  - Type of security demanded
- **Based on repayment period, there are three types of credit.**
  - **Short term credit:** usually repaid within 1 year
  - **Medium term credit:** usually repaid within 2 to 5 years
  - **Long terms credit:** repayable within 5 to 15 years
- **Depending on the type of security demanded , there are two types of credit**
  - **Soft loans:** these are offered with little or no security
  - **Hard loans:** these are offered against immovable assets as security such as land

b. Personal savings

- A farmer set aside part of his or her income to accumulate over a period of time and use it to buy capital assets needed for the production process.

c. Inheritance

- One may inherit capital from relatives or close friends

d. Grants or donations

- Individual farmers or groups of farmers may be awarded grants by sponsors or well wishers
- These grants or donations can assist farmers to start agricultural projects.

Conditions and term for borrowing

- Some general conditions include the following
  - Repayment period must be clearly stated
  - Interest rates have to be specified
  - Default .this species what happens in case one fails to pay on time
  - Loans are negotiated between applicant and financing institution
  - Before receiving the loan the applicants must sign the contract forms
  - Some financial institutions give credit against immovable assets

Difference between base interest and effective interest rates

a. Base interest

- This is the minimum interest rate that investors will accept for investing in a non-treasury security.
- It is set and published by commercial banks
- It is also known as the minimum interest rates or benchmark interest.

b. Effective interest

- Also known as effective annual interest, annual equivalent(AER),market interest rates discount rate or the annual percentage rate(APR)
- It is the interest rate on loan restated from the nominal interest rate as an interest rate with annual compound interest payable.
- It attempts to describe the full cost of borrowing. For example, a loan may have 10% interest rates because more interest is accumulated each month.

Calculation of effective interest rate of borrowed money

- Stated loan will be expressed as percentage
- Compounding periods will generally be monthly, quarterly, annually or continuous
- The effective interest rate is calculated through a simple formula

$$\boldsymbol{r = \left(1 + \frac{i}{n}\right)^{n} - 1}$$

Where **r** is effective annual rate, **i** is the nominal interest rate and **n** is number of compounding period per year.

Example

A loan with a stated interest rate of 8% that is compounded monthly, calculate effective interest

$$\boldsymbol{r = \left(1 + \frac{i}{n}\right)^{n} - 1}$$
$$\boldsymbol{= \left(1 + \frac{0.08}{12}\right)^{12} - 1,}$$
$$\boldsymbol{= (1 + 0.0067)^{12} - 1,}$$
$$\boldsymbol{= (1.0067)^{12} - 1,}$$
$$\boldsymbol{= 1.083 - 1,}$$

$= \mathbf{0.083 \times 100}$
$= \mathbf{8.3}\%$

Note: effective interest rate will always be greater than the stated rate.

- If the interest is compounded continuously, you should calculate the effective interest rates using the different formula.

  $r = e^i - 1$

  Where **r** effective interest rate, **i** is the stated interest rate and **e** is the constant =2.718

  Example 2

  Consider a loan with a nominal interest rate of 10% compounded continuously. Calculate the effective interest rate.

  $r = 2.718^{0.1} - 1,$

  $= 1.105 - 1,$

  $= 0.105 \times 100 =$

  10.5%

  Example 3

  If a farmer borrowed loan of MK400 000 at an interest rate of 16% to be repaid within one year.

a. Calculate the amount of money the farmer will have paid by end of the year.

First find effective interest rate

$$\boldsymbol{r = \left(1 + \frac{0.16}{12}\right)^{12} - 1}$$
$$\boldsymbol{= \left(1 + \frac{0.16}{12}\right)^{12} - 1,}$$
$$\boldsymbol{= (1 + 0.0133)^{12} - 1,}$$
$$\boldsymbol{= (1.0133)^{12} - 1,}$$
$$\boldsymbol{= 1.172 - 1,}$$
$$\boldsymbol{= 0.172 \times 100}$$
$$\boldsymbol{= 17.2}\%$$

Then calculate the amount of effective interest rate

$=\frac{17.2}{100} \times 400\ 000$
K68,800
Hence total paid will be: principle loan+interest
=k400 000+K68,800
=K468,800

b. Calculate the monthly payment of the loan: divide the total amount to be paid by the number of months of repayment

$=\frac{\text{k468800}}{12}$

=k39, 066.67

Exercise

Calculate the total amount of money Mr Banda, a farmer in mzuzu would pay if he gets a loan worthk2000 000 at an interest rate of 13% per annum and repays it within 5 years.

UNIT 9: CROP HUSBANDRY PRACTICES

- Land husbandry involves the practices carried out on a particular piece of land to create a suitable soil tilth in readiness for planting
- Land which has been prepared for purpose of growing crops is called a **seedbed**

Importance of land preparation

- To remove vegetation v=cover which interfere with the subsequent operations
- To bury organic matter into the soil this later decomposes. This helps in binding the soil particles as well as adding nutrients into the soil.
- To kill pest and disease causing micro-organism. This is by exposing the soil borne pest and disease causing organism to harsh environmental conditions on the soil surface, thus killing them.
- To kill perennial weeds, like couch grass, which otherwise compete with the crops.
- To improve the physical condition for the soil by loosening soil making it suitable for root development that is root penetration. This facilitates proper anchorage of plants.
- Improves infiltration of water.

Activities involved in land preparation

a. Land clearing

- Involves the following
    - Felling of trees and removal of tree stamps
    - Slashing or cutting of tall grass or shrubs or bushes
    - Burning of vegetation, though not recommended because it destroys soil structure and beneficial organism
- Can be done manually(hand method), using chemicals or mechanized(using machinery)

i. Hand method

- Uses hand tools like machete and slashes. And the use of these tools is slow and tedious, and may lead to delay in seedbed preparation and may result in late planting and consequently, poor crop yields. It is mostly used by small scale farmers

ii. Chemical method

- It involves the use of chemicals called herbicides which kill weeds. For example round up, gramoxone, atranzine, among others

iii. Mechanized method

- Involves the use of tractor mounted implements for example tractor with a chain to fell trees in the forest and bulldozers to remove stumps. This method is commonly used by large scale farmers.

Advantages

- It is efficient in land clearing
- It has low labour requirement
- Large areas can be cleared within a short time

Disadvantages

- The cost of purchasing and maintaining the machine is high

Importance of land clearing

- It makes subsequent land preparations such as ploughing, easier and efficient
- It helps in eradicating of pests and disease
- It helps open up virgin land which cannot be cultivated unless cleared first like bush or forest
- It is a land reclamation method, especially in warm humid bushy land. And these places are prone to tsetse fly infestation and are not suitable for human settlement and livestock keeping. And so clearing these area makes them habitable by people and livestock

b. Primary cultivation

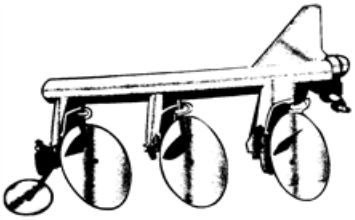
- This is the initial opening of the land either after clearing the bush or after previous season of cropping
- Can be carried out using hand tools or mechanically using various tractor drawn implements or ox-drawn ploughs.

Importance of primary cultivation

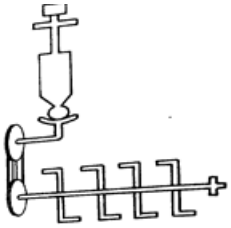
- It makes the subsequent operations easier
- It facilitates aeration and water infiltration in the soil
- It controls weeds, such as rhizomatous weeds, by burying or uprooting them
- It buries crop residues to decompose and add nutrients into the soil
- It ease the penetration of the crops roots
- It controls pest and disease. This is achieved when expose them to scotching sun or top predators. For example earth worms can be eaten by birds

Tools used in primary cultivation

- **Hand methods:** used by small scale farmers like hoes, forks hoes, ox-ploughs and among others
- **Mechanized methods:** used by large scale farmers like estates include disc ploughs, chisel plough, moudboards, rotary cultivators (rotavators).but initial capital and maintenance cost is high in this method.

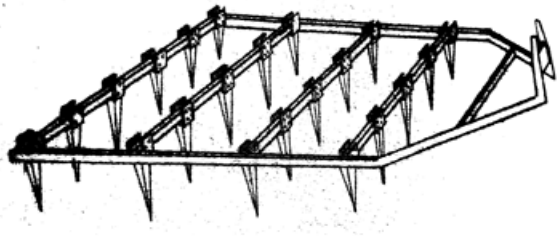


a disc plough

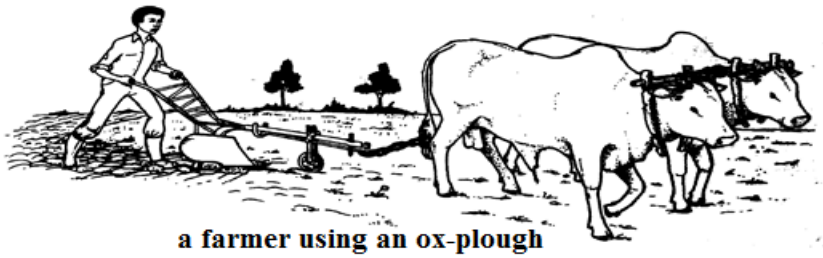


a rotavator

Mounted mould board in operation



spike tooth harrow



a farmer using an ox-plough

Factors that influence the choice of the tools and equipment in primary cultivation

- **Type of tilth:** this depend of the type of seeds to planted for example small seeds need fine tilth hence many tools are used.
- **Cultivation depth:** deep rooted crops require a tool that will plough deep into the soil
- **Type of soil:** heavy tools are required when ploughing heavy soils
- **Soil moisture content:** forked hoe may be more suitable than a regular hoe in wet soils
- **Size of the land:** there is need for heavy mechanical implements when dealing with large piece of land
- **Availability of capital:** one may choose a tractor-drawn plough due to high cost of purchase and maintenance. The farmer may instead opt for an ox-drawn plough because it is cheaper and can do the same work.
- **Topography.** In steep areas animals-drawn implements may be use but tractor implement cannot be used.

Timing of primary cultivation

- The best time to prepare the seedbed is during the dry season so that weeds can be scorched to dry by the sun. Early land preparation enables the farmer to plant early.

c. Secondary cultivation

- Done after primary cultivation and it involves seedbed refinement practices that are breaking large soil clods. It is also referred as harrowing

Factors determining the number of times secondary cultivation is done.

i. **Initial condition of the seedbed:** a roughly prepared seedbed during primary cultivation or opening of virgin land may necessitate more secondary cultivation.
ii. **Size of planting materials:** crops that have small-sized seed require a finer soil tilth and therefore secondary cultivation operation are necessary.
iii. **Slope of the land:** it is advisable to reduce the frequency of harrowing where land is too steep. This is because it pulverize the soil and makes it more prone to erosion
iv. **Moisture content of the soil:** wet soils require more secondary operations. Dry soil soils require less operation in order to conserve moisture.
v. **Type of implements used during primary cultivation:** some implement s are more effective than the others for examples land ploughed by discs leaves a lot of large clods and require more secondary operations.

Importance for secondary cultivation

- To break large soil clods into finer particles
- To destroy weeds which may be grown after primary cultivation
- To create a suitable tilth ready to receive seeds or other planting materials
- To incorporate organic material, such as crop residues, into the soil effectively for faster decomposition
- To level seed bed so as to facilitates uniform depth of planting and subsequent uniform establishment of crops in the field.
- To help in mixing organic manure, such as compost and farmyard manure, in order to accelerate the release of nutrients into the soil.

Tools used in secondary cultivation

- Small scale farmers use tools like forked hoe, rake, regular hoes, ox-plough can be used.
- Large scale farmers use tools like harrows, spike tooth, spring tines harrows and cultivators

Benefits of secondary cultivation

- the rate of work is faster thereby facilitating timely land preparations
- it is effective in burying weeds
- it is less laborious

Comparison of the hand method and mechanization

Mechanized method	Hand method
• the rate of work • efficient in burying • less laborious • facilitates timely land preparation	• the rate of work is slower • inefficient in burying weeds • very tiring • may delay land preparation

Relating final tilth to the intended planting material

- If the farmer intends to plant small seeds, the seedbed should be of fine tilth, where as big seeds require medium tilth. Large soil clods have a tendency of covering the seeds inappropriately, thus hindering their emergence.

d. Tertiary operations

- These are operation done on the seedbed which are necessitates the growing of certain crops. they are also called miscellaneous operations and the most common is ridging

Ridging

- Here soil is dug in continuous line and heaped on the side to from a ridge. Ridge are good for planting crops like Irish potatoes, sweet potatoes, cassava as well as ground nuts

Reasons for ridging

- To encourage free expansion of tubers as well as high yielding of groundnuts
- To make harvesting easy
- The furrows made in between the ridges helps to conserve soil and water
- Facilitates drainage in waterlogged soils

Crop varieties

a. Common maize varieties

- **SC403 :**
  - Takes 90-110 days to mature , hence an early maturing variety
  - It is drought tolerant
  - It is resistant to maize streak virus
  - It does well in dry areas under irrigation
  - Under good management , it can yields 3-6 tones per hectare
- **SC407**
  - Takes 90-100 days to mature, hence an early maturing crop
  - It is resistant to maize streak virus and grey leaf spot
  - Under good management , it can yields 3-7 tonnes per hectare
- **SC 513**
  - This is an early to middle maturing variety taking about 115days to mature.
  - It is drought tolerant
  - It is resistant to grey leaf spot disease
  - Under good management , it can yields 6-10 tonnes per hectare
- **SC627**
  - This is middle maturing variety taking 125-135 days to mature
  - it is resistant to grey leaf spot and maize streak
  - it is a high yielding variety, giving 7-10 tonnes per hectare
- **SC709**
  - this is an extremely late maturity variety, taking 130-150 days to mature
  - it shows resistance to grey leaf spot disease and maize streak virus
  - It is a high yielding variety, giving 11 tonnes per hectare.
- **SC717**
  - this is an extremely late maturity variety, taking 130-150 days to mature
  - it shows resistance to grey leaf spot disease

- it is yields long ears averaging in 13 tonnes per hectare

NOTE: SC denotes Seed Company which is the largest private seed provider in Malawi

- **ZM309**
  - this is an early maturing variety, commonly referred to as Mkawana sala
  - it is drought resistant variety, which does well in infertile soils
  - It is resistant to maize streak virus, grey spot and other diseases.
- **ZM 523**
  - This is drought tolerant variety which does well in infertile soils
- **DK 8021**
  - this is an early maturing variety taking 110-115 days to mature
  - it has a strong resistance to grey leaf spot disease
  - under good management it can yield 6-8 tones per hectare
- **DK 8033**
  - this is an early maturing variety taking 115-130 days to mature
  - it is adaptable to a wide range of areas
  - it produces two ears, giving a high yield of about 8-9 tonnes per hectare
- **DK 8051**
  - This is a middle maturing variety, taking 130-135 days to mature. it has a high milling suitability
- **DK 8071**
  - this is extremely late maturing variety, taking 140-145 to mature
  - it is also resistant to grey leaf spot diseases
  - it has high yielding giving 9-11 per tone

Common groundnut varieties

- **CG7 or Red Skins**
  - new variety in Malawi
  - commonly found in thyolo, balaka and mchinji districts
  - nut have deep red skin and are very uniform size and distribution
  - suitable for confectionery , oil extraction and peanut butter manufacture
- **Chalimbana**
  - the nuts are light to dark tan in colour
  - have a rich full flavour and ideal for confectionery and or cooking oil
- **manipitar**
  - this is a runner variety with seeds which are variegated red and white, their size and jape are irregular
- other varieties include Chalimabna 2005, Baka, RGI and Nsinjiro

Planting

- Is putting of seed or planting material into the ground to grow.
- Timely planting is essential for optimum crop yield especially when growing annual crop like maize and groundnuts

Benefits of timely planting

- It ensure that crop makes maximum use of the season's rains

- The crop is able to escape serious attacks by pests such as aphid and ,maize stalk borer
- The crop is able to effectively compete with weds
- The crop benefits from nitrogen flush
- It leads to early harvesting enabling farmers to take advantage of high market prices.

Selection of planting materials

Qualities of good seeds for planting

a) **Suitability to ecological conditions** like altitude, rainfall, soil type. For example maize variety like SC403,SC407 and DK8021 are early maturing and can do well in areas with short rains.
b) **Certified seeds** are those that have been tested and carefully selected based on the following qualities
   - High quality and potentiality for high yields
   - Disease resistance
   - Purity
   - Germination percentage
   - Free from physical damage

Planting maize

- Maize can be planted either manually or mechanically by use of seed planters
- Row planting is the most appropriate method of planting maize
- The recommended spacing is $90 - 100cm \times 25 - 30cm$.

Spacing however depends on

- Number of seeds per hole or station
- The cultivated variety grown
- Soil fertility
- Rainfall amount in the area
- Intended use of the crops

Marking planting stations

- When planting maize manually use a marked planting string to measure out the distance between planting stations
- The use of strings ensures that rows are straight and appropriate spacing is adhered to.

Seed rate

- The recommended seed rate for maize is 22-30kg per ha, that is planting 1-2 seed per hole. **However it may vary depending on;**
  - the spacing
  - number of seed per hole
  - intended use of the crops
  - soil moisture content
- number of seed to planted in area of land can be calculate as follows

$$\boldsymbol{number\ of\ seeds = \frac{size\ of\ land \times number\ of\ seeds\ per\ hole}{spacing\ of\ crops}}$$

Example 1: given that maize is planted 3 seeds per hole at a pacing of 90×25cm in a plot of land measuring 70×70m. calculate the number of seeds required.

$$number\ of\ seeds = \frac{7000cm \times 7000cm \times 3}{90cm \times 25cm},$$

=65,333 maize seeds

- Seed should be planted at the right depth. This is to ensure high degree of germination of the seeds. The depth of planting id influenced by;

- **Seed size**: the larger the seed the deeper it is planted
- **Soil type**: seeds are planted deep in light soil than in heavy soils
- **Soil moisture content**: seeds are planted deeper in dry sol than in moist soils

Planting depth

- Recommended depth of maize is 2.5-1ocm

Germination percentage

- After planting some seeds may fail to germinate because of factors like deep placement, inadequate moisture or attack by pest and diseases. Number of seed that have germinated can be expressed as percentage.

$$germination\ percentage = \frac{numberof\ germinatd\ seeds}{number\ of\ seeds\ panted} \times 10$$

Planting groundnuts

Seedbed preparation

- Prepare the soil to medium tilth

Time of sowing:

- Plant as early as possible. In areas with along wet season delay sowing so that harvesting coincide with dry weather t minimize loses of the crop

Sowing:

- seeds should be sown 4 to 10cm deep

Spacing:

- The recommended spacing is$45\ to\ 60 \times 10cm$. Close space in increase the spreads of rosette (a viral disease) disease which is spread by aphids.

Fertilizers and manures application

- Apply 125 to 250 kg of per ha of single super phosphate for high yields
- Farmyard manure application usually give good results

Weed control

- **Weed** is a plant growing where it is not wanted. Weeds have numerous negative impacts on crop production and so it is important to keep crop field free from them

Importance of weed control

- To reduce competition for nutrients, water and light with cultivated crops
- To control pest and diseases which may be harbored by some weeds
- To prevent contamination of farm produce which lower quality e.g *avena fatua*(namsongole)
- To eliminate parasitic weed like witch weed and *stri dnsiflora* which are parasitic to maize and other cereals
- To eliminate irritating weeds such as stinging nettle, *urtica dioca* (chilikumwamba) that irritate the farmers on the field hence lowering labour output
- To prevent blockage of irrigation channel by aquatic weed for example *salvinia spp.*
- To eliminate allelopathic weeds such as witch weed and *striga densiflora* (kaufiti) which produce chemical compounds that suppress or inhibit germination of seed crops

Timely weed control

- Weeds should be controlled at the right time. The following are the guidelines the a farmer may consider when controlling them
  - Control weed as soon as they appear
  - In leguminous crop, weeding should be done before flowering. This is because they are mainly self-pollinated and hence disturbances of the plants during flowering time may lead to low yield.
  - Weed should be controlled early before the set of seed and fruits
  - Weed control should be carried out when the soil moist to reduce incidence of damage of plants
  - Use of herbicides in we control should be done when the weed are actively growing

Frequency of weeding depends on

- **Type of crop grown:** some crops are able to smother weed and hence require only one weeding
- **Climate of the areas:** some climatic factors may favour fast growth f weed hence high frequency of weeding
- **Type of weed:** some weeds are fast growing and require regular weeding
- **Soil fertility**: soils rich in nutrients support faster growth of weeds hence high frequency of weeding**.**

Weeding in groundnuts

- Clear weeds during the early stages of growth
- Weeding after flowering should be discouraged as it interferes with the growth of the pegs

Weeding in maize

- First weeding done when maize is about 15cm tall. Subsequent weeding is done at intervals until maize plants establish a good cover. Hand weeding is done on small scale production. In large scale maize production, however, herbicides may be used.

Fertilizers application

- There is different type of fertilizer. They are applied at different stage of plant growth. For example **double super phosphate** is applied at plantings time because is not highly soluble in water hence less prone to leaching.
- **Nitrogenous and potasic** are applied after crops have established in field because they are more soluble in water, hence prone to leaching.

Application Methods of chemicals fertilizers and organic fertilizers

- **Broadcasting:** the scattering of fertilsers on land and then it is incorporated into the soil. This can be done by hand on small scale and fertilsers spreader on a large scale.
- **Drilling:** direct placement of fertilsers into the hole or furrow and later is mixed with soil. It is also called hole placement or dollop method.
- **Side dressing or banding:** this is the placement of fertilizer in continuous or discontinuous patterns beside the crop. It is done mostly on perennial crop because they have got extensive root system. It is used a top dresser since root have developed already. In side dressing fertilsers is placed on one or two pots beside the crop and ring application, fertilsers is placed in a circle around the plant
- **Foliar application:** this is the spraying of fertilizer in solution form on the leaves of the crops. It is use in applying urea and micro-nutrients. The response is quick as fertilizer is absorbed through the leaf surface
- **Injection into the soil.** This is used in specialized case such as in green house. In this method, fertilsers, in liquid form are injected into the soil under pressure
- **Irrigation method:** in this method, fertilizer is mixed with and applied with the irrigation water. It is also called *fertigation*

Factors t consider before applying fertilizers

- Soil analysis should be done to establish the level of nutrients in the soil
- The soil PH should be determined to ensure it is appropriate for the type of fertilsers
- The availability and amount f soil moisture
- The method of application
- The quantity and cost of fertilizers required
- Time of application

Summary of various types of fertilizers

fertilizers	Formula	Forms of available for plant use	colour	appearance	Soil reaction	Nutrients composition
ammonium	$(NH_4)_2SO_4$	NH_4^+ and so_4^{2-}	white	Crystalline	acidic	21% N and 26%S
Ammonium nitrate	$(NH_4NO_3$	NO_3^- and NH_4^+	white	Crystalline	acidic	34-35% N
Ammonium sulphate nitrate	$(NH_4)_2SO_4 + NH_4NO_3$	NO_3^- and NH_4^+	Yellow or orange	Granular	neutral	26% N and 13.5% S
Calcium ammonium nitrate	$(NH_4NO_3 + CaCo_2$	NO_3^- and NH_4^+	grey	granular	acidic	21% N 10-20%N CaO
Urea	$Co(NH_2)_2$	NH_4^+	white	granular	Neutral	45-48% N

Double or Triple super phosphate	-	$PO_{4^{2-}}, SO_{4^{2-}},$	Grey	granular	Neutral	18-21%P_2O_5
Soda phosphate	-	$PO_4{}^{2-}$	grey	Powderly	Neutral	20% P_2O_5, 40-50% CaO and trace elements
Basic slag		P_2O_5,CaO	grey	Powdery	basic	15-16% P_2O_5,, 40-50% CaO and trace elements
Potassium chloride (muriate of potash)	KCL	K^+, Cl^-	White to red	crystalline	neutral	48-62% K_2O impurities of Ca. Mg, S and some trace elements
Potassium	K_2SO_4	K^+,$SO_{4^{2-}}$	Yellow	crystalline	Neutral	42-52% K_2O

Fertilizers grade or analysis

- It is important to know the amount of nutmeats contained in fertilizers. This is made possible by calculating its fertilizer grade

$$\boldsymbol{percentage\ of\ nutrient = \frac{nutrient\ content}{total\ eight\ of\ fetilser} \times 100}$$

- Fertilizers grade must be known in order to determine correct amount of nutrient or fertilizer to apply per unit area

Calculating rate of fertilizers application

- Farmer us e fetilser5 analysis to calculate the amount of nutrients or fertilizers to apply on farm.
- Once the recommended rate is known it is easy to calculate nutrient required per hectare

Example 1:
how much of $\mathbf{P_2O_5}$ in 850 kg of single phosphate (18% $\mathbf{P_2O_5}$)?
the single superphospahte is $850kg$,
the percentage of $\mathbf{P_2O_5}$ **in it is 18%,**
weight in this is $\frac{18}{100} \times 850kg$,
= $153kg$

Example 2 : a farmer wants to apply 60kg of N per hectare on his Irish potato farm. How much sulphate of ammonia (20% N) does he require?

for every 100% *sulphate of ammonia fetilser there is* 20% *N in it,*

thus in a $100kg$ *SA there is* $20kg$ *N in it*

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$\therefore what\ amount\ of\ SA\ does\ 60kg\ of\ N\ contain = less,$

$, \frac{60}{20} \times 100 = \mathbf{300}\boldsymbol{kg}$

The fertilizers ratio

- **Fertilizer ratio** is the relative percentage, expressed as a ratio of the NPK present in the fertilizers.
- For example 17-17-17, can be expressed as fertilizers ratio of 1:1:1
- To calculate ratio, use the smallest figure t divide through the rest
- The fertilizers ratio is only expressed in compound fertilizer

Liming of soil

- Liming is the application agricultural limes to an acidic soil in order to amend it.
- Lime contains calcium in form of limestone ($CaCO_3$) and hydrated lime ($Ca(OH)_2$).

Importance of liming

- It removes toxic elements such as aluminium from acidic soils
- It improves soil structure through flocculation of soil particles
- It reduces the acidity of the soil
- It hastens the decomposition of organic matter by improving micro activity
- It avails nutrients like nitrogen and phosphorous in absorbable forms
- It improves nodulation in legumes

Major diseases of maize and groundnuts

- **Crop disease** may be defined as an alteration in the state of plant or its parts which interrupts normal functioning.
- **Pathology:** the study of the cause, origin and nature of plant diseases
- **Pathogen:** a disease causing organism, such as protozoa, bacteria, virus, fungus and nematodes
- **Vector:** a disease carrier like aphids which transmit viral in rosette disease

Classification of crops diseases

- Hey are classified into three major groups
    - Fungal disease
    - Viral disease
    - Bacterial diseases

i. Fungal diseases

- Caused by fungus
- The fungal lives on plants as parasites and attack plants parts such as roots, leaves, stems or fruits
- Parasitic fungi are made of threadlike structure called **mycelia** which produce see like structure known as **spores**.
- The spores may be carried to other plants by wind, water or other pests
-
- Examples of fungal diseases are *smuts, blights, rusts and damping off*

ii. Viral diseases

- They are caused by microscopic organisms called viruses. The general symptoms of viral disease are
  - **Chlorosis:** this is the yellowing of the leaves
  - **Stunted growth:** the plants exhibits dwarfness
  - **Mosaic mottling:** these are light and dark patches found on the plants leaves
  - **Necrosis:** this refers to the death of plant tissues such as leaves, stems or fruits
  - **Leaf curl:** these are curved or spiral shaped leaves
- **Examples of viral diseases***: tristeza, maize streak, greening disease of citrus, tobacco mosaic, rosette and ratoon stunting disease of sugar cane*

iii. Bacterial diseases

- Bacterial are microscopic pathogens that are larger than viruses and cause severe damage to plant cells
- Examples of Bacterial diseases include *black arm of cotton, bacteria wilt in potatoes and tomato canker in tomatoes*

Major diseases of maize and groundnuts

Disease	Casual agent	Symptoms	Control measures
Maize smut	Fungu sustilago maydis	• Plants severely dwarfed • Abnormal development of tassels • Black masses of spores on the cob and tassel	• plant resistant maize varieties • use certified seed • Crop rotation • rogueing
Maize rust	Fungus punccina spp	• red brown Powderly pustules on leaves	• practice crop rotation • plant resistant varieties • plant early
Maize streak	virus	• yellow parallel lines on the leaves which eventually turn yellow with long strips of green patches • stunted growth in plants during early periods f growth • cobs produced are often half filled or contain few seed or no seed	• plant early • Crop rotation • rogueing • use certified seed • field hygiene
Grey leaf spot disease	Fungus cercospora zae maydis	• leaf lesions • chlorosis • leaf blight	• destruction of crop residues • plant resistant varieties • Crop rotation • use certified seed • weed control • use appropriate fungicides
rust	Fungus puccina arachidis	• orange coloured pustules appear on the lower leaf surface and rupture	• observe quarantines • spray appropriate fungicides

		exposing brown spores • leaves become necrotic	
Alternarial leaf disease	Fungus alternaria spp	• lesions which are brown and irregular shaped with yellowish halos • leaflets turn light to dark brown colour • sleaves become necrotic	• use appropriate fungicides
Diseases of groundnuts			
Early and late leaf spots	Fungus cercospora spp	• lesions which are dark brown with yellow halo • leaves become chlorotic, then necrotic and later fall; off	• practice crop rotation • remove volunteer groundnut plants • spray appropriate fungicides
Fusarium wilt	Fungus fusarium oxysporum	• young seeling become yellow and wilt • plants dry up and die	• seed treatment with appropriate fungicides
nthracnose	Fungus colletrichum arachidis	• small water soaked yellowish spots appear on the lower leaves • the lesions enlarge and cove entire leaflet	Spray mancozeb
Dry root rot/dry wilt	Fungus macrophomina phaseolina	• water soaked yellowish spots appear on the lower leaves • spots spread upwards to the aerial parts and down into the roots • death of plants	• irrigation • seed treatments
Bud necrosis/bud rot/bud light	Virus tomato spotted wit	• death of terminal buds • chlorotic rings on leaves • stunted growth • small distorted molted leaves • small and reduced pods in late infections	• early planting • control vectors • plant resistant varieties • intercropping • seed treatment • field hygiene
Groundnut rosette virus	virus	• Chlorotic in the whole plant • Stunted growth • Small curled leaflets • dark green mosaic	• early planting • control vectors
Ground blight	Fungus sclerotium rolfsii	• wilt occurs in patches and a white mycelium is found on the roots • sunken brown lessions on the leaves	• spray appropriate fungicides

Harmful effects of disease

- They decr4eae crop yield by altering the normal plant physiological process interfering with the plants growth or killing it.
- Lower crop quality. this affects grading for marketing
- Some diseases may lead to contamination of crops. for instance, aflatoxins produced by fungi in poorly tore cereal can poison and kill consumers of the produce
- disease control increases the cost of production

Disease control measures

a. cultural measures

- These are agronomic practices use to reduce the infestation or spread of plant disease without the use of chemicals. these include the following
  - use of disease free planting materials-use of certified seed
  - use of disease resistant varieties prevent crop infection by particular disease
  - quarantine regulation to help prevent introduction and spread of disease in new field areas or into the country
  - practicing of field hygiene that is rogueing and destruction of infested crop residues
  - Crop rotation-it leads to the break the life cycle of particular disease the introduction of another crop which not host specific.
  - Proper seedbed preparation-this exposes soil-borne pathogens to sun thus killing them.
  - Proper pruning-which eliminates the humid micro climates within the tree bush making it unsuitable of disease causing organism. For example coffee berry disease is controlled by this method.
  - hot water treatment of sets helps to control ratoon stunting in sugar cane
  - proper drying of cereals and pulses helps to prevent occurrence of aflatoxins
  - proper spacing-closer pacing minimizes the spread of rosette disease

b. chemical control measures

- Involves the use of chemicals to eradicate the disease or kill the disease vector. they include
  - Seed dressing of planting material with the appropriate chemicals for example Lindane and cerasan to control seed-borne fungal disease.
  - soil fumigation or sterilization by use of appropriate chemicals-for example Lindane to control soil borne disease
  - Spraying crops with appropriate chemicals as preventive or curative measure. for example spraying coffee with Delan or Daconil for the control of Coffee Berry Disease

c. biological control measures

- This method involves the use of living organism to control crop disease.
- The living organisms are aimed at reducing population of pests that are vector to crop disease.
- For example, the lad bird beetle is predator of aphids thereby reducing their population thereby lowering incidence of viral diseases transmitted by aphids like groundnut rosette, maize steak, citrus tristeza and citrus greening.

d. legislative

- this involves use of laws passed by parliament that prohibits introduction of crops disease into the country
- these include

- **quarantine administration**-prevents the introduction of plants materials from regions of known disease outbreak
- **seed certification**-for imported products to ascertain that are free of diseases
- **Notification order**-to ensure that disease are controlled in time before they cause much harm through posting of pictures showing diseased crop.

Crops pests

- pest are categorised into two;
    - field pests
    - storage pests

i. **field pests**

- These attack either maize or groundnuts while growing in the field. they include
    - insects peats such as aphids and maize stalk bore
    - rodents such as rats and moles
    - birds as weaver bird (quelea aethiopica-mpheta) and mouse bird
    - some mammals such as apes, monkeys, antelopes and buffaloes

ii. **storage pests**

- These pest attack grains in their places of storage. the common ones are weevils and rats

Major pest of groundnuts

a. red hairy caterpillar

- The larvae re hairy reddish brown with black bands on either heads or top abdomen. They have long reddish brown hair all over the body.

Symptoms

- Cause loss of leaves of crops. all leaves eaten away leaving the man stem only

Control measures

- deep ploughing during the dry season
- early sowing
- intercrop with castor for every 5 rows of groundnuts
- use of crop rotation
- use of trap crops
- irrigation
- field hygiene

b. groundnut leaf miner

- Shiny white eggs are laid singly on the underside of the leaflets. the larvae is green with dark head and prothorax

Symptoms

- brown blotches on the leaf
- leaflets stuck or webbed together
- severely attack fields looked burnt from distance

Control measures

- use cowpeas or soya beans as trap crops
- use of crop rotation
- field hygiene
- mulching with rice straw cause reduction in leaf miner attack
- intercropping
- chemical control with appropriate insecticides

c. gram pod borer

- Eggs are spherical in shape and creamy white in colour. The colour of larvae could be between green to brown. it is dark brown grey lines on the body with lateral white lines

Symptoms

- larvae feed on flowers and buds
- symmetrical holes or cutting scion on leaflets

Control measures

- deep ploughing during the dry season
- intercropping
- use of chemical insecticides

d. groundnuts aphids

Symptoms

- wilting of tender shoots during hot weather
- stunting and distortion of the foliage and stems
- they excrete honey dew on the which sooty moulds form a black coating
- acts as a vector for groundnut virus

Control measures

- timely sowing
- hand picking and destruction
- use of chemicals insecticides

e. Jassids

- adults have elongated wedge-shaped bodies, active and green in colour

Symptoms

- whitening of veins and chlorotic patches
- heavily attacked crops appear yellow and scotched

Control measures

- timely sowing
- us of crop rotation
- intercropping with millets
- use of irrigation
- chemical control with insecticides

f. Thrips

- These are small slender and yellow-black coloured insects. they have piercing and sucking mount parts

Symptoms

- tender leaves show yellowish green patches on the upper surface and brown necrotic areas and silvery sheen on the lower surface
- stunted plants

Control measures

- spray insecticides

g. termites

Symptoms

- wilting of plants
- termites penetrate and hollow pit the tap root and stem thus killing plant
- bore holes into the pods and damage the seed and this weaken the shells making them liable to entry and growth of fungus that produce aflatoxins

Control measures

- destroys termites colonies
- use well decomposed manure
- timely harvesting
- chemical control with insecticides
- irrigate frequently
- seed treatment

h. white grubs

Symptoms

- feed on roots and damage pods
- grubs feed on root hairs, resulting in pale wilted plants drying in patches

Control measures

- deep ploughing in dry season
- use well decomposed organic fertilsers
- early planting
- chemical control with insecticides
- seed treatment

i. pod borer

Symptoms

- young pods showing holes with excreta inside
- pods without seeds

Control measures

- chemical control with insecticides
- soil sterilization

Major pests of maize

a. maize stalk borer

- They feed on aerial part of maize. They affect leaves and stems have characteristic window or holes. They move through the stems tunneling them resulting in weakened stems which later fall off.

Control measures

- remove and destroy all crop residues
- apply Endosulfan or Diazinon granules down the funnel of each plan when maize is about 30cm high
- practice early planting
- practice close season of at least two seasons
- practice crop rotation

b. pink stalk bore

- Larvae bore into the stems of maize plants weakening the plants. early attack results in destruct5ion of the plants central shoot

Control measures

- field hygiene
- use of recommended chemical insecticides
- destruction of planted alternate host crops

c. maize aphids or plant rice

- these are soft, dark green insects which feed in clusters and found in the inflorescence especially when there is water storage in the soil
- they suck sap from the green husk of cobs and leaves .the attacked leaves and husks appear black in color

Control measures

- early planting
- use of recommended chemical insecticides

d. maize webworm

- The larvae are long and dark brown in colour.
- hey form silken webs on cobs
- larvae first fed on the leaves preceding flowers removing the chlorophyll and later on the milky grains
- they form webs around the ,maize cobs and flowers

e. army worms

- Feeds on crop leaves.
- they move in large swarms and eat up all the vegetation during their invasion

Control measures

- use of recommended chemical insecticides

f. weevils

- the adults have long curved snout which they use to bore into the gains
- damage is caused by their larvae as well as their adults

Control measures

- use of recommended chemical insecticides
- timely harvesting

g. rat

- These are rodents and have sharp strong teeth capable of gnawing, breaking and chewing. they are very destructive in stored grain

Control measures

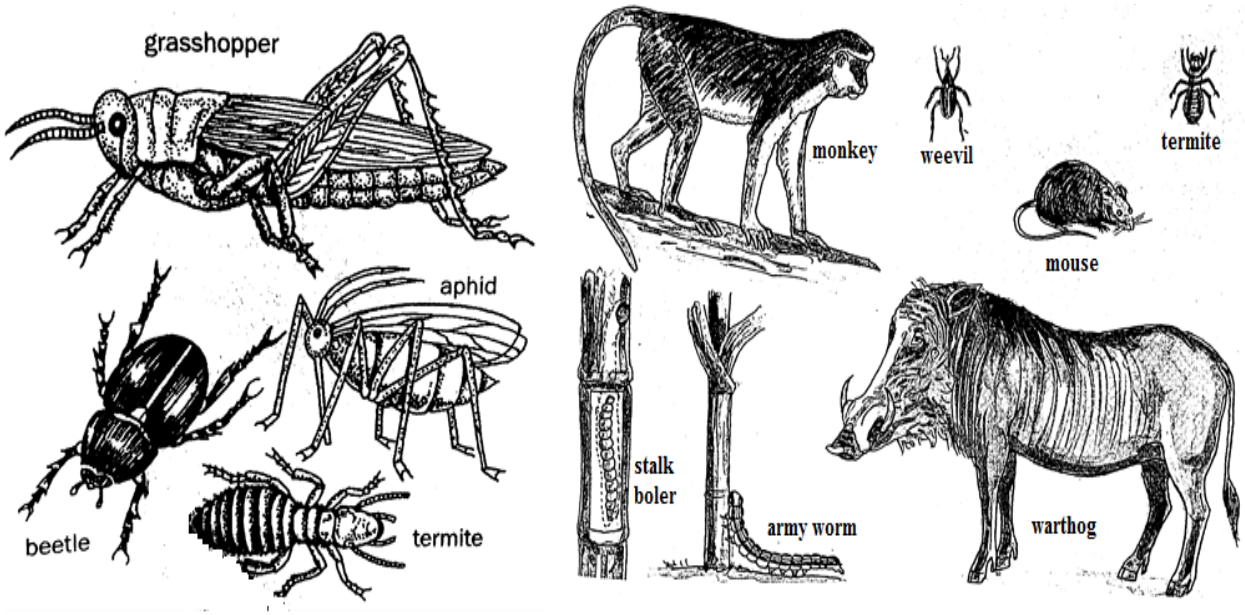
- use of recommended chemicals
- biological control through use of cats
- use of traps

Harmful effects of pests

- pest cause physiological destruction to crop by eating leaves, stems, roots or flowers tissues
- if not controlled, pest can cause considerable reduction to crop yields
- Some pests lower crops quality. for example, cotton stainers stain cotton lint lowering the crops quality
- some pest are disease vector sucking pests such as aphids, mealy bugs and some cotton stainers transmit viruses and fungi causing disease infection in crops
- Some pests suck sap, depraving the plant of its food leading in low yields.

Pest control practices

- Minor pest may be tolerated in case the damage is not very serious. when pest population cause damage beyond what can be contained the infestation is said to have reached **economic injury level**
- Therefore necessary control measures and assessment of the nature of damage must be undertaken.



Some pests of maize

Categories of pest control measures

a. cultural control practices

- this is the manipulation of the environment, making it unfavorable for survival of the pest

Examples control practices include

i. **Use of clean planting material:** Planting of seeds or vegetative materials free from pests helps in establishing pest free from crops pest.
ii. **timely planting :** this enables the crops to grow healthy and escape peat attack like stalk borer in maize
iii. **Proper seedbed preparation:** should be prepared during dry season and this helps to expose soil borne pest to adverse conditions or predatory birds which eat them up.
iv. **Resistant varieties:** for example, highly tillering sorghum compensates for short fly attack, whereas goose necked sorghum discourage birds.
v. **Weed control:** Some weeds are host specific to pest and therefore controlling weds in fields of crops helps avoid pest attack in the crops.
vi. **Observing fields' hygiene:** this involves farming practices that ensure little or no plant materials that may harbor pest in the fields like burning previous crops residues helps to control bollworm and rogueing controls scales.
vii. **mulching:** the pest attach themselves on the mulch exposing themselves to predatory agents like in coffee thrips and antestia bug which can easily be predated on
viii. **Close spacing:** this is the period during which a particular crops deliberately not grown in the given area in order to control pest build up.
ix. **Traps crops:** these are crops which attracts pets diverting the main crop. Pest can be killed by use of to other means on the trap crop. For instance rows of sorghum in maize filed reduce incidence of stalk borer attack on maize as the adults fly prefers the sorghum plants.
x. **Proper spacing:** when crops are properly spaced it becomes difficult for pests move from one plant to another. however, closer spacing in groundnut reduces aphids attack

xi. **Timely harvesting:** harvesting crops in good time prevents serious attacks by pests. for example, delay in harvesting maize exposes the crop to extensive damage by rats and weevils

xii. **Crop rotation:** crops which are more susceptible to particular pest are alternate with others which are not susceptible for it so as to control such as a pest.

xiii. **Proper plant nutrition:** healthy plants to be more resistant to pest attack, for example, aphids cause minimal damage to healthy beans crops. This is achieved by application of right mounts of mature and fertilisers.

b. mechanical pest control practices

- It involves using means to kill the pest and crating physical barriers to prevent pests from getting into contact with their target crops.

i. **Irrigation or flooding:** irrigation drowns pests such leaf miners and aphids while flooding suffocates mole in the soil. Overhead washes aphid from cabbages.

ii. **Use of lethal temperature:** helps to control pest in post –harvest management practices. For instance, hot water is used to control the pink bollworm in cottons seeds.

iii. **Suffocation:** some storage bins are filled with carbon dioxide to inhibit pest multiplication or survivor.

iv. **Hand picking, trapping and killing:** this involves catching the pest and killing. It effective in controlling pest such rats, moles, birds and giants loopers using special traps.

v. **Creation of physical barriers:**

- Metals plates fixed on posts for raised granaries prevent vermin like rats from gaining entry into the stores.
- Use of sticky materials on tree trunks helps to control pests like scales in citrus tree.
- Fences physically keep off the large animals.

vi. **Proper drying**: crops must to dry to very low moisture in storage. This ensures the produce is hard is enough to limit pest damage on the grains. Cereal can be stored after proper drying (to a moisture content of 11-13%)

vii. **scare crows**

- Scares crowns are human figure-like objects used to scar4e ay birds and other large animals from the fields of crops. Animals such as monkeys and squirrels have been successfully controlled by this method.

viii. **use of explosives**

- These are thrown at breeding places of birds at night to kill or scare them off.

ix. **distress calls**

- Sound of a captured pest or that of its predator is replayed from a loud speaker scaring away pest.

c. biological pest control practices

- These are methods which employ the use of living organisms which are natural predators of the pests.

Table 2: predators and their target pest

predator	Target pest
Parasitic wasp	White fly in citrus, coffee mealy bug
Lady bird beetle	Aphids, cotton cushion scale
Praying mantis	Giant lopper
Cats	Moles, rats and mice
chickens	Cotton stainers and termites

Advantages of biological method

- self-perpetuating
- cause no environmental pollution

- save labour

Disadvantages of biological method

- it takes too long to research for correct biological agent

d. chemical pest control practices

- This is the use of chemical to control pests. the chemicals are known as pesticides
- the application of pesticides is done in the number of ways
- dusting
- spraying
- fumigation of the soil and the produce
- sterilization of implements

Classification of the pesticides

- can be classified in the following aspects;
- mode of entry
- types of target pests

a. **mode of entry**

- **stomach poisons:** these enter the pest through the mount during feeding and poison the pest
- **Contact poisons:** these kill the pest when it comes into contact with the chemicals as they get absorbed through the skin cuticle.
- **Fumigants:** these enter the pest respiratory system in form of fumes suffocating the pest to death.
- **Systemics:** these chemicals maybe applied to the soil or directly on the plants. They are absorbed into the plant tissues where the chemicals are translocated to other plants parts such as stems, leaves and flowers. When pests feed on such plants, they get killed.

b. **type of target pests**

- on this basis, we have the following classes
  - **Insecticides:** they include *diazinon, dimethoate, fenthion* and *fenitrothion.* These kill insects.
  - **rodenticides:** these kill rodents such as rats, mice and squireels, examples nomui and red cat
  - **Nematicides:** these kill nematodes. examples are *nemcur, nemagon* and *tumic*

Factors that affect the efficiency of applying pesticides

- **concentration of the pesticides:** a pesticides has a higher efficacy when applied in its correct concentration
- **Weather condition at the time of application:** rain water washes way the pesticide. Therefore, avoids applying chemical on rainy days.
- **Timing of application:** the efficiency of the chemical is high when applied at the time whether pest is most susceptible, such larvae or nymphal stage rather than at the adult's stage when some pets may become resistant to the pesticides.
- **Persistence of the pesticides:** those pesticides which have along residual effect are more effective in killing pests. this is because such pesticides retain their strength for long before breaking down into constituent compounds which are harmless
- **Pest resistance:** Some pests have developed resistance to certain pesticides and this reduces their efficiency.

Advantages of chemical pest control

- it is relatively fast method of pest control
- it has lo labour requirements

Disadvantages

- chemical are very expensive to perchance
- chemicals that have long residual effects may cause environmental pollution such as DDT
- use of chemicals requires skills especially in mixing and application
- due to the broad spectrum effects, some pesticides can destroy beneficial soil organism and predator insets such as ladybirds, beetles, butterflies, bees and birds
- some target pest may build up resistance, hence rendering the chemical ineffective

e. legislative pest control measures

- This involves enactment of laws by the parliaments that prohibit entry of crop pests from other countries.
- All crop imported to Malawi must be inspects and certified as free from pests before it can be released for use.

f. integrated pest management

- This is the new strategy of pest control which combines various pest control method. cultural, biological, physical and use of pesticides are all practiced in a bid to reduce pest population

Crop harvesting procedures

- Crop should be harvested on time to reduce losses through destruction by rains, birds and rodents. Immature harvesting lead to cracked grains and harvesting at wrong stage lower the quality of the produce or even render the product unusable.

Factors to consider when determining the stage of harvesting crops

- **intended use of the crops:** for example ,maize for silage is harvest wholly when is at the silking stage, green maize is harvested when the cobs are not dry, maize for shelling is harvested when it has dried properly
- **prevailing weather conditions:** crops such as cotton must be harvested during dry periods before onsets of rains to prevent losses
- **Market demand:** a crop can be harvested earlier when the market demand is high. This allows the farmer to benefits from the higher market prices.
- **Pest and disease outbreaks:** pest and disease attacks can be influenced the stag of harvesting such as weevils or rodents attacks crops on maize can be prevented by early harvesting.

Harvesting of groundnuts

- There are various stages of harvesting groundnuts. they include;
  - lifting
  - drying
  - shelling

a. lifting

- should be lifted when most of them are mature

- maturity is indicated by darkening of the vans on inner surface of the shells and yellowing of most of the leaves
- delay in harvesting may lead to crop losses through germination of some nuts
- Harvesting is done by hand pulling in standby soil or use of hand hoes in heavy should. Mechanical harvester may also be used to lift the seeds.

b. drying

- After lifting plants, turn them upside down and leave them to dry in the field for few days. The nuts are then removed by hands.

c. shelling

- hand shelling or hand operated machines can be used in shelling nuts

Harvesting maize

- Maize is ready for harvest in 3 to 5 months depending on the cultivar and altitude.
- Maize is harvested when the leaves and husks are dry. Maize crop may be cut and stoked in the field to allow cobs to dry. The cobs are then removed by hand and stored.
- Maize can also be harvested by use of combined harvesters in large scale. The maize cobs are later shelled.

UNIT 10: PIG PRODUCTION

- pig farming is profitable enterprise compared to keeping other livestock , such as cattle, sheep and goat because of the following reasons
  - they have high prolificacy: a sow is bal to give birth to several piglets at fallowing up to 16 piglets
  - gestation period is shorter, 115 days
- However pig farming is not exploited in Malawi because of the following reasons which hamper big production.
  - **religion**: Islamic communities neither rear pigs nor eat their products
  - **culture**: some communities do not accept pig rearing and their products
- pigs are reared for either pork or bacon production
- **Pork** is meat from young pig weighing 45-50kg at 4 months old. The meat is not salted. Bacon is meat from an old pig weighing 110kg lives weight slaughtering at 7-9month. **Bacon** meat is salted. It is normally obtained from back and sides of the pigs.
- pig provides bristles used for making synthetic leather fabrics

Breeds of pigs

- there are two breeds of pigs
  - local breeds
  - exotic breeds

a. local breeds

- local breeds in Malawi are not commonly reared for commerce purposes and majority of them are owned by women

Characteristics of local breeds

- they have high ability to utilize fibrous feeds and red sorghum better
- higher parasite and diseases control
- superior organoleptic properties
- suitability to organic production

- local breed are predominately black, but some are black and white, black and brown and white and brown

Reasons for sidelining local pigs

- negative perception against the local breeds
- negative perception against free range production system
- lack of access to markets and viable marketing strategies
- general lack of information with regards to carcass and processing quality of local pigs

b. exotic breeds

- the exotic bred of pig include the following

(i) large white

- **origin:** Yorkshire in Britain
- It is widely reared in many part of Malawi. It is mainly kept for pork production.

Characteristics

- is long, large and white in colour
- has erect legs
- has a dished face and snout
- most prolific of all the pig breeds
- has good mothering ability
- can be affected by sunburn
- matures late
- good coveter of feeds into meat
- fairy hardy
- has strong hind legs
- has a sagging back and a level underneath

(ii) Danish landrace

- **origin:** Denmark
- **colour:** white

Characteristics

- longer than the large white
- ears are long and droop(hung down) over the face
- good for bacon production
- as prolific as the large white
- has good mothering ability
- requires high level of management skills
- the back is sagging(drooping) and hind legs are weak
- has straight snout

(iii) Essex saddle back and Wissex saddle back

- **origin:** south of England in Britain
- **colour:** black with white band that runs down the shoulder in most breeds
- **shape:** body is long and curved

Characteristics

- have a straight snout
- good for pork and bacon production
- excellent for extensive rearing system
- good foragers

- excellent mothering ability
- has drooping ears

➢ Essex saddle back is similar to wissex addle back only that all legs of the wissex saddle back are white

(iv) Berkshire

- **origin :** England
- **colour:** black with white feet, face and tail end

Characteristics

- face is dished
- ears are erect
- produce good meat especially bacon

(v) tam worth

- **origin:** England
- **Colour:** red, carrying light dark. its often referred to as sand pig

Characteristics

- breeds is good for bacon production
- has long legs
- slow growth rate
- hardy hence can do well in extensive systems rearing
- sows are not prolific(unproductive) and they have poor mothering ability

(vi) duroc jersey pig

- **origin:** Britain
- **colour** : pure black

Characteristics

- good for meat but carcass is of poor quality
- fast growth and early maturity
- sows produce large litters
- sow have good mothering ability
- due to black colour they do not suffer from sunburn

Management systems for pig production

➢ there are there systems for rearing pigs

- extensive system
- semi-intensive
- intensive system

(a) extensive system

➢ This system of pig rearing where they are allowed to move and forage freely in an enclosed piece of land.
➢ A simple structure is constructed to provide shelter at night and against bad weather.
➢ forage can be supplemented with kitchen waste and crop remains

Advantages of extensive system

- low capital investments

- does not require a lot of skills
- droppings are evenly spread in the field
- less laborious

Disadvantages of extensive system

- increase piglet mortality due to chilling
- high livelihood of predation or theft
- pigs take long to reach market weight
- cannot be practiced where the size of land is small
- has low profits per unit area

(b) semi-intensive system

- This is the system that combines extensive and intensive systems of rearing pigs.
- Pigs are raised in pens and outsides at different stages of growth.
- When outside, they look for feed by foraging but those indoors are provided with sufficient feed, water and other requirements. the piglets and fattening stock are always kept indoors

(c) intensive system

- Pigs are permanently kept indoors in a structure known as *piggery.*
- They are provided with adequate feds and water at all times. This system is most appropriate for commercial pig rearing.
- Pig put on weight faster than other systems; it is easier to control parasites and disease. The pigs can also be easily being managed.

Advantages of intensive system

- can be practiced even on a small piece of land
- allows a higher stocking rate
- pigs reach market weight early
- pigs are secure against predation or theft
- piglets are protected from adverse weather conditions
- has high profit per unit area
- manure accumulates faster

Disadvantages of intensive system

- parasites and disease may spread fast
- requires high capital investments
- requires a lot of skills
- requires lot of labour

Breeding of pigs

- the selected male and female pigs should be mated at the right age and weight
- Piglets should be mated at until 12months old, weighing about 100kg
- a sow should be served 4 days after weaning her piglets
- Sow or gilt should be mated when it shows the sign of heat. The sow on heat is taken to the Boer to ensure successfully mating after which it is returned to her pen. The farmer should return of heat on mated sow or gilt after 21 days and repeat mating.
- Natural mating is the most common method in serving pigs.

- **Flushing:** the practice of giving high quality feeds to sow 2 to 3 weeks before mating. This helps to induce heat period.

Signs of heat period in pigs

- restlessness
- there is clear slimy mucous discharge from vulva
- swollen and reddening of the vulva
- frequent urination
- occasional grunting
- loss of appetite
- it mounts other pigs in pens
- it stands motionless when other mount

Gestation

- This is the period of time from conception to farrowing. it last for 12-115days (3month, 3 weeks and 3days)
- During the gestation period sow should be fed be fed on adequate feds and clean drinking water and concentrates.
- During the last 3 weeks of farrowing the in pig sow or gilt is fed on extra high quality feed. This is **steaming up.**

Importance of the steaming up

- ensure strong and healthy piglets
- Stimulates growth of alveolar tissue of udder thence more milk production upon farrowing.
- ensure a strong and healthy sow less likelihood of complications during farrowing

Management of pigs during parturition

- preparation for parturition should be done one week before the expected date

Signs of parturition in pigs

- it becomes restless and begins to collect bedding materials at one corner to make a nearest nest
- loss of appetite
- the udder and teats become enlarged and filed with milk
- the vulva becomes enlarged and red
- the muscles on either side of the tail slacken

Preparation for farrowing

- deworrm the sow
- wash and spray the sow against ectoparasites using appropriate chemicals
- clean and disinfect the farrowing pen
- take the sow to the farrowing pen at least 5-7 days before the expected date of farrowing to familiarize it with the environment

- Provide a farrowing crate so that the piglets are born in perfect and well protected environment. this ensure the piglets are not cannibalized by the sow
- Create a creep are with infra-red light. This keep. this keeps the young piglets warm and protects them from pneumonia
- Two days to farrowing, feed the sow entirely on bran which acts as laxative. mix sow and wiener meal with wetted bran and feed the animal up to 2-3 days after farrowing
- provide clean water adlibitum

➢ The sow furrows with no difficulty and do not interfere but watch closely. Normal partition takes 2-4 hours although many sows take a lesser duration. If it is having difficulty a contact a veterinary officer for assistance.

➢ If piglets get stuck close to the vulva, the attendant should shift the piglets into proper position and pull them out as the sow labours. Ensure that the sow is pressed own by use of a farrowing crate. the attendant must thoroughly wash the hand and wear gloves providing any assistance

Care after farrowing

- Ensure the piglets are breathing properly. remove mucous from the mouth and nostrils using clean cloth
- ensure the piglets are safe by moving them away from the so as each is born
- Tie, cut disinfect the navel chords of each piglet. disinfect by applying iodine solution
- Weigh each piglet and record the birth weight.
- remove and discard he afterbirth and any still born
- count and record the number of piglets born
- Place the piglets under infrared light. In the absence of infrared light, chilled piglet can be immersed in lukewarm water up the head, and then dried. Keep them in warm place until they gain enough strength, and then take the piglets to the sow for suckling.

Rearing piglets

➢ piglets are very delicate and high mortality rates can be experienced within the 3 days due to

- **being crushed by mother**: this is prevented by providing a farrowing crates and guard rails in the farrowing
- **Chilling (cool weather):** is prevented by providing an infra-red build or any other source of hat in the creep area.
- **piglets anemia:** is controlled by providing iron supplements to the piglets either in form of iron paste, smeared on teats of the sow or inform of solution injected intravenously into piglets

➢ ensure pigs get colostrums and later enough milk up to the 10^{th} day

➢ A day after farrowing carry out *teeth clipping.* This is the cutting of sharp canines at gum level using a teeth cutter.

Importance of teeth clipping

- avoid injury of the sow's teat or udder hence reduce incidence of mastitis
- reduce the likelihood of piglets injuring one another when playing or fighting
- makes the piglets docile, hence easy to handle
- reduce incidence of piglets injuring the farmer during handling of piglets

Castration

- it is the process of removing the testes from animal
- it is carried out on male not selected for breeding

Methods of castration

- **Open castration:** a scalpel blade is used to remove tests surgically. Treat the wound with disinfectants. it is the most common methods in pigs
- **closed castrations :** a burdizzo is used to crush the spermatic cords above the testes to stop supply of blood to testes
- done at the age of 3 weeks

Procedure for castration

(i) gather the tools and materials that is scalpel, disinfectants and cotton wool
(ii) retrain the piglet appropriately
(iii) using one hand, squeeze the testes and hold
(iv) disinfect the scrotal surface
(v) using scalpel make an incision on the scrotum
(vi) squeeze out the testis through the incision until the spermatic cords is extended
(vii) cut the spermatic cord using a scalpel
(viii) repeat the above procedure for the other testis
(ix) disinfect the wound
(x) release the piglet

Advantages of castration

- it controls breeding
- it controls breeding diseases
- it prevent inbreeding
- it enhances growth rate of piglets
- it makes the piglets docile hence easy to handle

Piggery

- **piggery or pig sty:** is the house structure for pigs
- Piggery should prove warm and well ventilated because pig are very sensitive to extreme weather conditions. It is more emphasized in intensive system.

Essential features of a piggery

(a) **farrowing pen:**
- it is used for farrowing and ensuring the safety of the piglets
- it is provided with farrowing crate to prevent sow from lying on the piglets
- provide heat source to protects piglets against chilling
- it contains creep area where only piglets can access creep feed

(b) **Weaner pen**: it is where weaned pigs are kept. it should have a feeding, watering and resting sections
(c) **Boar pen**: this is where breeding boar is kept. It gives room for sows to be served during the breeding seasons.
(d) **gilts pens:** it is used for keeping young female pigs up to the age of service (usually 12 months)

Other parts of piggery unit include

- **feed store:** this is used for storing feed
- **records room**: this is used for keeping feed and eight record
- **Running yard**-this is an extension of the pens. the yards are used for dunging and for sunbathing
- **water troughs or drinking nipples**: these are used a watering points for the pigs

Qualities of a good piggery

- easy to clean
- drought free especially the farrowing pens
- well lit
- well ventilated
- floor should drain away urine and water
- leak-proof roof
- farrowing pens should have guard rails
- must be strong because other pigs can destroy structure
- floor should be easy to clean
- The flow should free draining to avoids accumulations of water which can results in disease infections.

Maintenance of a piggery

- clean the unit regularly
- change the bedding regularly
- repair any broken parts
- avoid by repairing leaking roofs

Feeding pigs, major parasites and disease of pigs and their control and prevention

➢ Pigs' hsouldbe4 fed on the right type of feds as per their age.

(a) piglets stage (10 days –to 8 weeks)

- pig continue getting the milk from their mother sow and they are introduced to creep feed on the 10^{th} day
- the quality given per piglet is initially low and gradually increased as the piglets increase in size
- the practice of giving young animals additional high quality feeds in form of pellets to supplement mother's milk is referred to as **creep feeding**
- Each class of animals has a specific requirement for their young ones. For examples, in piglets, it is carried out from 10 days of age to 4 weeks in lambs, it is done from 2 weeks to 14 weeks of age, while in killings, it is done from 4 weeks after birth.

Importance of creep feeding

- it leads to higher weaning weight
- it promotes fast growth because the young do not rely on the mother's milk only
- it helps in full development of the digestive system as they young get accustomed to digesting solid fed in addition t the milk
- It prevents over-sucking of the mothers thus promoting good body condition at weaning.

Qualities of good creep feed

- highly digestible
- high in energy contents
- highly palatable
- rich in digestible crude proteins (between 20-24%DCP)
- rich in mineral such as iron and calcium among others
- rich in vitamins A,B and complex and D

(b) **weaner's stage (8 weeks 50kg)**

- the weaners are fed on sow and weaned meal

(c) fatteners' stage (50kg-market**)**

- the pigs are fed on pig finisher or fattener meal
- they should be given adequate fed in respect to their body weight
- pig finisher meal has the lowest digestible crude protein (DCP) level, which is 12%

Weaning

- This is the gradual introduction of solid feed and gradual reduction of milk consumption in piglets.
- The piglets are separated from the mother sow at 8 weeks of age.

Weaning process

- piglets can be weaned through the following systems
  (a) **old weaning system at 8 weeks**
- Weaning piglets at this age natural processes since milk decline and solid feed consumed by piglets is sufficient to meet about 70-80% nutritional requirements.
  (b) **recent system at 4-6 weeks**
- This involves separation of the mother sow and piglets at 4-6 weeks of age. The piglets' solid fed consumption account for 50-60% of the nutrients requirements and therefore no serious problem should be encountered with weaning at this age.

Factors considered when weaning

(a) Piglet immunity: passive immunity from colostrums is transient and declining to very low concentrations by 14 days of age.

- piglets do not start building its own active immunity until about 21 days of age
- Acquiring active immunity is a slow process even if they are exposed to antigens as part of the disease control program. so piglets have little protection for another 2-3 weeks

(b) Post weaning fertility-early waning does not necessarily lead to fast return of the sow into oestrus.
(c) availability of skilled attendants to take care of the piglets
(d) availability of proper facilities
(e) feed costs

Advantages of very weaning

- better disease control: piglets are separated from mothers sow when their passive immunity is still high, hence cannot get by pathogens in mothers' body
- uniform piglet growth is achieved

- there is better sow productivity

Disadvantages of very early weaning

- they is potential delayed fertility is sows especially gifts
- Every early weaning requires very special facilities such as isolated, precisely controlled environment adjusted as piglets grow. very early weaning relies on competent and attendant
- early weaning relies on competent and dedicated attendants

Basic essential for satisfactory weaning

- **Minimizes distress:** piglets should be properly pre-conditioned and kept with some members of the same liter.
- **Physical environment:** maintains piglets within the pens. Have adequate group sizes such as 10-20 per pen. So that they can handle together to effectively conserve heat when it's very cold.
- **feeding:** provide palatable rations that meet all nutritional requirements of the piglets

Wallowing in pigs

- This is unique behaviour of pigs whether they roll on and spread their bodies with mud.

Importance of wallowing

- it has cooling effects; wallowing is more frequent in hot weather
- it helps to control sun burns especially those with low pigmentation
- it helps to control external parasites

Common parasite of pigs

1. **roundworms**

- Most common internal parasites in pigs. They are cylindrical in shape and pink or white in colour. The adult measures more than 8inches long. The adults live in the small intestine.

Life cycle of roundworms

- eggs laid in the primary host are passed out in the feaces
- On the ground they hatch into infective larvae 10 days after being laid. This infective stage is called encyst and is resistant to adverse environmental conditions, it can remain viable up to 30 years.
- the encyst are found on grass where they are picked by grazing pigs
- They then bore brought the intestinal wall into walls into the bloodstream and carried into the liver and then into the lungs where they penetrate into the trachea. they are coughed out into the mouth and are re swallowed
- In the intestine, they develop into adults worms and start another cycle. Male and female worms mate and upon fertilization, female lay eggs

Signs and symptoms of roundworms attack

(a) retarded growth
(b) scours
(c) anemia
(d) pot belly appearance

(e) diarrhoea
(f) constipation

Control measures against roundworms

(a) avoid rearing pigs in muddy grounds
(b) avoid grazing pigs in wet grass in the morning when the larvae are active
(c) de-worm pigs using appropriate dewormers regularly

2. whipworm

- This is other common endoparasites in pig production. It inhabits the alimentary canal of pigs.

Signs and symptoms

- loss of appetite
- diarrhoea with mucus an blood stains
- dehydration
- death

Control measures

- raising pigs in confinement
- deworming with appropriate dewormers

3. mange

- This is the major external parasites of pigs. They live on the skin of pigs. They burrow through skin layer digesting the issues.

Signs and symptoms of mange

- Thickened and reddened skin around the ears, shoulders, stomach and between the legs.
- Animals will scratch themselves until they damage their skin.

Controls measures

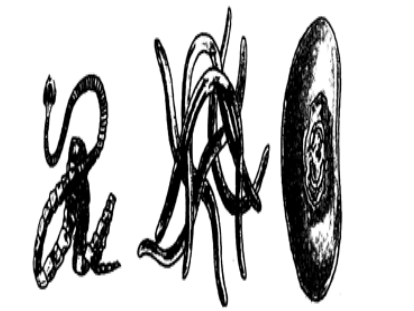
- by washing the animals clean
- spray with appropriate acaricides

4. mites

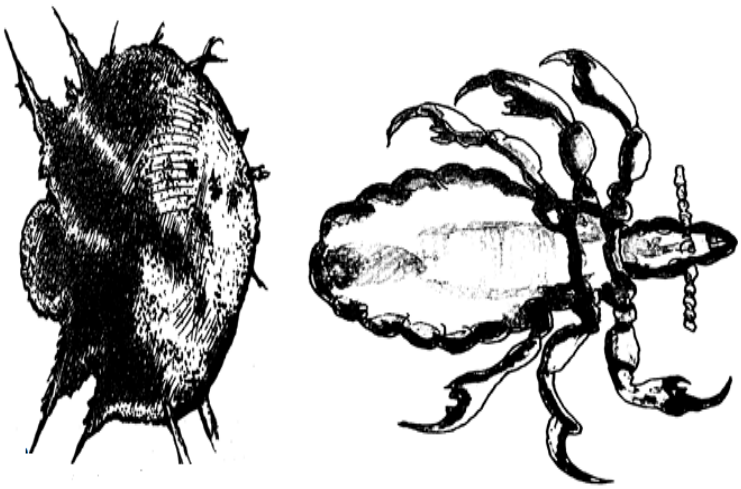
- These are eight-legged round-bodied crawling arachnids. They are white in colour and have dark legs.
- they also burrow into the skin of pgs causing great irritation

5. lice

- they are wingless insects with a diamond-shaped body
- they are blood sucking insects



Internal parasites of pigs



external parasites

Common disease of pigs

- the following are common disease of pigs

1. African swine fever
   - It is caused by *iridovirus* which is transmitted by contact with wild pigs or through contact with infected garbage. transmission is also possible by ticks of *ornithodoros spp*

Signs and symptoms

- fever of about $40℃ - 41℃$
- Paralysis of hind legs. the pig moves about its forelegs only
- difficulty breathing
- constipation followed by blood stained diarrhoea
- lack of coordination of the nervous system
- pig skin, snout, abdomen and ears appear blue
- lacrimation this is the watery discharge from the eye
- coughing and vomiting

Control measures

- keep off wild pigs
- do not fed pigs on garbage
- slaughter and properly dispose of the affected pigs
- carry out quarantine

2. **pneumonia**
   - This disease infects the lung tissue. it is common disease of piglets

   Causes
   - it caused by bacterium *mycoplasma mycoides*, viruses dust particles or presence of worms in the lungs

Predisposing factors

- poor ventilation
- overcrowding
- **age:** young animals are more prone to disease than adults
- dampness and chillness in the pig house

Signs and symptoms

- severe respiration problems
- abundant mucoid nasal discharge
- fever
- piglets appear dull
- loss of appetite
- abdominal lung sound s such as bubbling, hissing and gurgling
- after slight excise, piglets coughs due to congestion of bronchioles

Control measures

- keep piglets in warm pens
- treat cases of the disease with antibiotics
- avoid overcrowding in animal pens
- ensure proper ventilation in the piggery

3. **piglets scours**
   - this disease is also referred to as *colibacillosis* or white scours

   Cause

   - a bacterium known as *Escherichia coli* which usually attacks young piglets during the first week of birth
   - *Escherichia coli* inhabits the animals intestines

   Predisposing factors

   - Unhygienic conditions in the house of piglets. dampness and chilly conditions in the piggery contributes to the development of scours
   - poor feeding practices such s overfeeding of the piglets, lack of colostrums or irregular feeding programmes
   - abrupt temperature changes
   - Deficiency of vitamin A

Signs and symptoms

- white or yellowing diarrhea with pungent smell
- rapid dehydration
- initial rise body temperature but which later drops below normal
- extremely cold touch
- dullness
- undigested milk curd
- blood and mucus stain occur in the feaces
- soil tail and back of the thighs
- loss of appetite

Control measures

- ensure clean lines
- proper feeding
- observe hygiene during parturition

4. **piglets anaemia**

➢ Disease of piglets because they are born with limited sully of iron. if the piglet does not have access to iron in the first 2-3 weeks, it red blood cells capacity to absorb oxygen is impaired

Cause

➢ insufficient or disease red blood cells

Signs and symptoms

- pale skin
- rapid breathing
- jaundiced sometimes slight yellow appearance
- mucous membranes of the eyes are pale
- sours, sloppy diarrhoea
- signs of haemorrhage
- general weakness

Control measures

- administers iron injection within the first week after birth
- give iron to piglets

Control and prevention of disease and parasites in pigs

➢ the farmer should strive to keep his pig healthy though the following practices

- cleaning and disinfecting the pig house
- cleaning the feed and water toughs and disinfecting them
- practice routine deworming of the pig to control endoparasites
- wash and spray the pigs using appropriate chemicals; to control external parasites
- isolates sick pig to prevent spread of disease
- administer iron injection or paste to piglets to control piglet anaemia
- treat sick pigs using appropriate drugs to prevent spread disease
- practice proper disposal of carcass to prevent spreads of diseases
- keep away wild pigs from the farm to control African swine fever disease
- maintain a footbath at the entry of pig house to prevent introduction of disease
- in case of outbreak of African swine fever, all animals should be slaughtered and carcass disposed of properly