FARM STRUCTURES

Farm structure refers to a facility constructed on a farm for storing farm produce, tools or equipments, housing animals, human beings and handling animals for various treatments.

Examples of farm structures include;

- Fences
- Farm buildings such as farmer's house of residence, crop stores, poultry houses, zero grazing structures.
- Animal handling structures such as: -Plunge dips, Spray races, Crushes, Fences
- Water storage structures like tanks.
- Farm roads
- Irrigation structures like over head tanks sprinkler irrigation structures and dams
- Dairy units
- Zero-grazing units
- Poultry houses
- Rabbitry
- Fish ponds
- Bee hives
- Silos
- Green houses
- Pig stys
- Nurseries

FENCES

A fence is an enclosed piece of land that forms an effective barrier to livestock movement and excludes intruders from the farm.

BENEFITS/IMPORTANCES OF FENCES OR FENCING LAND

- Fences facilitate rotational grazing; fences can be used to divide the grazing land into paddock and this allows the farmer to practice rotational grazing.
- Fences help in controlling ticks and other internal parasites like liver flukes, tape worms. Double fencing eliminates/prevents ticks movement to the farm, because the area between the double fence is kept free of vegetation making it very difficult for ticks to cross over.
- Fences minimize spread of disease by restricting wondering animals from other farms.
- Fences enable grouping of animals according to their ages which makes feeding more easy.
- Fences help to avoid land disputes since they establish a farm boundary which gives clear demarcation of farmer's land.
- Fences enable mixed farming to be practiced easily.
- Fences improve security of the farmer i.e. offer protection to the farmer and his properties by keeping away thieves and tress passers/intruders.
- Fences reduce labour requirements on the farm i.e. animals can be left to graze on their own on the farm.
- Fences improve on the beauty of the farm hence make them attractive.

- Fences enables farmers to diversity their farming activities. E.g. when the farm is well fenced, the farmer can be able to carry out very many enterprises i.e. grow crops, rear animals, fish farming, e.t.c
- Fences allow separation of animals for different specific reasons. e.g. Isolating sick ones for disease control, parasite control, calving, mating, etc, according to sex, age, type.
- Live fences serves as wind breakers to guard against the harsh effects of strong winds on farm crops, animals and the soil.
- Fences safe guard water points, they protect areas around water points from being overgrazed and trampled upon by the animals.
- Fences help to control inbreeding on the farm.

DISADVANTAGES OF FENCES/PROBLEMS ASSOCIATED WITH FENCING LAND.

1. Fences encourage land fragmentation which makes use of machines difficult on the farm.
2. Fences deny animals chances of feeding freely to find the best feeds
3. Fencing requires a lot of capital per unit area
4. Fencing requires skilled labour to erect e.g. barbed wire fence, wooven wire fence
5. Fences like hedge fences harbor dangerous organisms like snakes.
6. Some fences e.g. shrubs like lantana are poisonous to animals.

Types of fences

Fences are usually classified according to the materials used to construct them. I.e.

- Dead fences
- Live fences

a) Live fences

These comprise of electric fences, trees and shrubs. Live fences are also collectively called Hedge fence.

Plants commonly used as hedges include:-

- Euphorbia spp
- Cypress spp
- Acacia spp
- Tick berry
- Ficus spp
- Sisal (Agave spp)
- Prickly pear cactus (Opuntia spp)
- Kiel apple
- Bougaine villae
- Mauritius thorn.

Some of these plants used as live fences have the following features:-

- They have sharp protruding structures e.g. thorns.
- Some Species have an irritating smell while others are poisonous to animals.
- Others produce latex.

N.B. These features make them some what repellant to animals and intruders.

Advantages of hedge fence

- Live fences are cheap to establish.
- Hedges act as wind breakers when fully established.
- When well trimmed, hedge plants, make the farm look beautiful.

- Hedges require less maintenance once established.
- Hedge fence gives a permanent demarcation to settle land disputes.
- Hedges act as a source of fire wood/fuel.

Disadvantages of hedge fences

- They take long to establish and make an effective fence.
- Gaps may occur when the hedge plants die.
- If the plants used are thorny, they can injure animals
- They can also act as hide out for vermines, thieves and wild animals, snakes etc.
- Hedge plants compete with crops for nutrients.
- Hedge plants require regular trimming because they have continuous growth.
- Some species of hedges are poisonous to livestock e.g. Ficus Spp, Lantana, Euphorbia, etc

Electric fence.

This type of fence is movable and widely used on dairy and beef farms. Electric fences are used where strip grazing is practiced. They are constructed using metallic posts, insulators, electric wires and a source of electricity e.g. Battery.

A piece of land is fenced with an electric wire and current is passed through the wire such that when the animal comes near the wire it receives a small stock enough to make it run away. Normally this electric fence is used on a temporally basis but not permanent basis.

Structure of an electric fence

Advantages of electric fence.

- Can be easily moved from one location to the next as required.
- They do not need a lot of labour to construct.
- They restrain animal movement very well.

Disadvantages of electric fences

- They require regular inspection and maintenance which makes them expensive.
- They are only applicable under highly productive enterprises.

b) Dead fences

These are made of non-living materials which include:-
Wires, Blocks, Stones, Bricks.

i. **Wooden fence** made of wooden treated timber posts, poles and tree branches.

Advantages of using wooden fence.

- Cheap to construct especially in areas where wood is readily available.
- They are effective in restraining small animals such as goats, sheep, etc.

Disadvantages of wooden fence.

- Not durable especially when untreated.
- Require frequent repair and replacement
- Animals can easily break the fence.

ii. **Trench fence**.

Here trenches are dug along the boundaries of the farm. These trenches should be dug deep and wide enough to prevent animals from jumping over.

Advantages of Trench fence.

They are very effective in preventing animals from straying.

Disadvantages of Trench fence.

- Requires a lot of labour to dig the trenches
- Livestock and people may fall into the trench and get injured especially when vegetation over grows and covers them up.
- Trenches can trap water during the rainy season which acts as breeding grounds for parasites.
- Trenches occupy plenty of land that would otherwise support grazeable vegetation with a boundaries of trenches are bound to collapse inside, which makes it easy for animals to cross over them.

iii. Wall/stone fences.

Constructed using stones, concrete or clay bricks held together by mortar.

Advantages of stone fences.

- Act as wind breaker
- They are durable
- They offer full security as it is not easy for livestock to go through them.
- Low maintenance costs

Disadvantages of stone fences

- The cost of construction is high
- Their construction requires skilled labour.

iv. Wire fences

The components of wire fence are posts, wire and staples.
They are 3 groups namely:-

- Woven wire fence
- Plain wire fence
- Barbed wire fence

a) Woven wire fence / chain link

A plain gauge wire is woven into different patterns to make a sheet of wire mesh or net.
It is some times referred as chicken wire or wire mesh or chain link.
It is not common on small scale farms for its very expensive.
It is used for enclosing poultry and pigsty run as well as fencing stone like rabbits, sheep and goats.

ASSIGNMENT 1

Draw a structure of a wooven wire fence

b) Plain wire fence.

This fence is the regular gauge wire without barbs. It's not commonly used on many farms but rather used in combination with barbed wire in single strands. Plain wire fences are only used for quiet animals (animals with a mild temperament)

Advantages of using plain wires.

Effective in restraining small sized animals e.g. goats
They do not cause injures on animals skin like barbed wire fences.

Disadvantages of plain wire

When used alone, they are not effective in restraining animals

c) Barbed wire fence

This type of fence is made of ordinary gauge wire with barbs on it located 8-15cm apart it is also made of tight stretched wire supported on upright posts in the ground.

The wire is fixed on the poles by means of stapples (U-nails)

N.B Barbs discourage any animal attempts to jump over or find its way through the fence. However this creates damage on the hide and skins of the stubborn animals.

Structure of barbed wire fence

Components of a barbed wire fence

- Dropper
- Strainer posts/ corner/king post
- Standard post
- U-nails

Advantages of barbed wires fences

- They are very effective in controlling movement of large animals such as cattle, Donkeys

Disadvantages of barbed wire fence

- Barbs can easily cause damage to hides leading to loss of quality.
- Wounds inflicted on animals can as entry points for disease causing organisms.
- They are not effective in restraining small animals such as pigs, sheep and goats

Procedures of erecting the barbed wire fence.

- Clear the land where the fence line is to pass to a width of about 2m to allow ample working space.
- Use pegs to set the position of posts in a straight line either by sighting or else a guide rope or cord.
- Using a sisal rope/string, establish straight line between adjacent pegs along which posts holes are to be dug.
- Using the recommended spacing, mark out the spots where post holes are to be dug.(spacing of posts depends on the type of livestock to be confined)
- Using the hole digger or post auger, dig holes to a depth of 90 cm for king posts and 60-75cm for intermediate posts.
- Erect the strain posts and support them with struts.
- Unroll the barbed wire from one corner post to the other beginning with the lower strand of wire.
- Fix the end of the to one corner posts.
- Move to the other corner post in the direction of the unrolled wire.
- Using the wire strainer, stretch the wire to the required tension.
- Attach the wire to the post using staples.
- Then erect the intermediate posts, making sure that they are all contact with the strand of wire already installed.
- Finally install the remaining strands of wire until the fence is complete

Tools used to construct a barbed wire fence include;

1. **Post hole digger/earth auger.**
   Is used to dig holes ranging from 15-40cm in diameter depending on soil conditions.
2. **Fencing pliers/ tin snip**
   Used to cut wires
3. **Wire strainer**
   Used to stretch or tighten the wires so that they do not sag or give way when pulled a part.

4. **Rammer.**
   Used to ram soil around the post so that it holds the post firmly in the upright position.
5. **Claw hammer**
   Used to hit and drive staples into the poles/ posts.
6. **Had saw.**
   This is used to cut down posts to the required length.

7. **Tape measure**
   It is used to measure the distance between posts and wire strands so that they can be correctly spaced.
8. **Sisal string**
   It is used to ensure that the fence is straight.
9. **Staples /U-nail**
   These are used to attach the wire on to the posts

The major components of barbed wire fences

i. **Strainer posts/king post**
   These are large posts fixed at the corners and gates to take strain of the wire. Strainers are 2.4m long and 16-18cm in diameter.

ii. **Struts.**
   Are also called supporters and are used to support strainer / king post. They are 2.4m long .

iii. **Standard posts.**
   These are used to hold wires between one corner and another. They pull the wire in both direction and so there is a less strain of them. Standards are 1.8m long and 5-15cm in diameter.

iv. **Dropper.**
   They do not touch the ground. They are placed in between the standards which keeps the wires in position when being pushed apart by animals. Droppers help to stop the wires from sagging.

Fencing calculations.

Formulae

i. No. of posts = $\frac{\text{Perimeter}}{\text{Spacing}} + 1$

ii. No. of Rolls of barbed wire = $\frac{\text{Perimeter}}{\text{Length of 1 roll}} \times$ No. of Strands

iii. No. of staples = No. of Poles x No. of strands

Example I

A farmer wants to construct a 3-strand barbed wire fence on a rectangular piece of land measuring 800 by 500m.

Given that the length of 1 roll of barbed wire is 400cm and that the spacing between I post to another is 5m.

Calculate

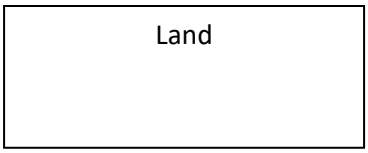
i. No. of Posts.
ii. No. of Rolls of barbed wire
iii. No. of staples.

Solution

No. of Post = Perimeter / Spacing

But perimeter = 2(L+W)

Rectangular land



500m

800m

Perimeter = 2 (800+500)

But L = 800m

W = 500m

P = 2 (800 + 500)

=2 (1300)

Perimeter = 2600m

Spacing = 5m

= 2600m / 5m

= 520 posts

No. of Rolls= perimeter x No. of Strands

Length of 1 roll = perimeter = 2600m
Length of 1 roll of barbed wire = 400m
No. of strand = 3
No. of Rolls = 2600 / 400 x 3

= 26 / 4 x3

= 19.5

= 20 Rolls of wire

No. of staples = posts x No. strands
Posts = 520 posts
No. of strands = 03 strands
No. of staples = 520 x 3 = 1560 staples.

Exercises (1)

1. Mr. Mukasa is a livestock farmer in Nkoko village where he would like make a fence as shown below.

- Size of land 260 by 70m
- Fence with 5 strand of wire

- 1 Roll of wire 200m long
- Distance between the fencing posts 8m.
- Cost of fencing wire = 125,000 per roll
- Cost of staples = 4500 per kg
- 1 Post costs 1800

Calculate;

i. No. of posts
ii. No. of Roll of wire
iii. No. of kg of staples to use if 1 kg of staples contains 15 staples.
iv. Total of cost of fencing materials to be used

Exercise II

Your school farm has leased a piece of land measuring 500m by 300m. You are required to fence the perimeter using wooden poles and 48 strands of barbed wire. The poles are spaced 50m apart. A roll of wire measures 600m. a gate is 5m wide to be provided:-

a) Outline the criterion followed when erecting a wire fence of such kind.
b) Calculate;

i. The No. of posts required.
ii. The No. of Rolls of wire needed
iii. The No. of staples to be used.

Exercise III

A farmer has a rectangular piece of land measuring 2000m by 900m around which a 3 strand perimeter barbed wire fence is to be constructed. Given that the length of 1 roll of fencing wire is 560m spacing between the fencing posts is 8m with 4 gates provided.

Calculate;

i. No. of posts required.
ii. No. of Rolls of wire to be used.
iii. No. of kg of staples if 1 kg contains 10 staples

b) Calculate the total cost of;

i. Fencing wire if 1 roll of fencing wire costs 90,000
ii. Staples if 1 kg of staples cost 6,000

Treatment of fencing posts.

Posts for fence construction are usually treated with chemicals and protected against fungi and insects before being used.

Methods used when treating/preserving wooden posts are:-

- Vacuum / pressure method
- Sap displacement / end diffusion method
- Soaking method i.e. hot soaking method and Cold soaking method.

- Surface painting / spraying.

Examples of chemical used for treating wood/ wood preservatives include:-

1. Pentachlorophenol
2. Old engine oil
3. Tributyl /tin oxide
4. $CuSO_4$

} kills weevils and other insects.

5. Dieldrine (16% of 10ml) Termites
6. Arsenic pentoxide
7. Sodium dichromate } fungi

8. Tar
9. Creosote } Weather
10. tarnex

a) <u>pressure / vacuum treatments</u>

Here freshly cut poles are peeled and packed into sealed cylinders where chemicals are forced into them under very high pressure.

Procedure.

- Poles are obtained from the source
- Poles are peeled to remove the back and cut into desired sizes.
- Poles are immersed in chemical preservatives like creosote in cylinder.
- Poles immersed in preservative in cylinder and covered.
- Chemical is forced into poles under very high pressure.
- Poles are removed, chemical drips off and taken for use.

b) <u>Sap displacement /end diffusion method.</u>

Here poles are immersed in preservative for a given time and later removed and inserted upside down to enable complete coverage of the chemical.

Procedure.

- Freshly cut poles are obtained from the source
- Poles are cut into desirable sizes and peeled to remove the bark
- Poles are inserted into freshly prepared preservative for about 4-6 days.
- The sap in the poles evaporating up wards /diffuses up wards and is replaced by the preservatives.
- After 4-6days, poles are inserted upside down to enable the complete coverage by the preservative.
- After the poles are removed and taken for use.

c) <u>Hot soaking method</u>,

Poles are cut; the back stripped off and then submerged in a tank containing the preservative. The container/ tank is then heated for about 2 hours until the preservative is about to boil. The chemical with posts still immersed and is allowed to cool which makes wood cells to expand and take in the preservative.

<u>Question 1</u> Describe the procedure followed when preserving wood using Hot and Cold soaking methods.

a) Describe the steps followed when carrying out of surface painting

d) **<u>Cold soaking method</u>**

Posts are cut and backs striped off. Posts are then immersed in a preservative for a few days to allow the preservative to be drawn up into the conducting tubes of wood. Poles are removed and left to drip dry

Surface painting

Is where wood is painted /brushed with appropriate preservatives?

Guiding questions,

1. Explain why it is important to construct fence on the farm/
b. Describe various types fences found at the farm.
c. Name the tools which a farmer should have in order to make a barbed wire fence.
2. Describe how each of the following method of wood preservation is done.
i. sap displacement method.
ii. Pressure / vacuum method.
3. Describe the procedure followed when erecting a hedge fence on the farm.
4. Mention 5 precautions farmers should consider when seasoning wood at the farm.

Wood seasoning

Seasoning is the removal /reduction of moisture from wood.

Reasons for wood seasoning.

- Prevents /reduce wrapping of wood due to uneven expansion of wood.
- Prevents decay/ rotting of woods.
- Seasoning improves durability and strength of wood

Precautions taken when seasoning wood/ timber.

- Provide a shade over wood to keep off rain and sun shine.
- Heap the stances above the ground so as to avoid absorption of moisture and allow an circulation.
- Piles of wood should be separated by wooden rods called stickers to allow passage of air into the stance.
- Supports and stickers should be spaced close together to avoid wrapping of wood.
- Piles of timber should be as much as possible be parallel to the ground to avoid bending

Animal handling structures.

These are structures used by farmers to carry out routine livestock farm operations. They make it easy for farmers to handle and perform certain operations on farm animals.

They include;

- The plunge dip
- Spray race
- The crush

a) The Crush

Is a structure used to restrain farm animals when carrying out management operations on them?

It is made used timber poles or steel poles.

Structure of a crush (draw from lib)

The length of a crush depends on the number of animals a farmer would like to handle at once. It constructed in such a way that it is narrow at the bottom and wider at the top.

N.B It should be narrow enough to prevent animals from turning once it has entered the crush.

Uses of the crush.

The following operations can be carried out in the crush.

- Dehorning animals.
- Used for dewaming/drenching the animals for spraying and hand dressing of ticks/ parasites.
- Used for artificial insemination.
- Carrying out pregnancy diagnosis to find out if cows are pregnant.
- For applying identification markers on animals e.g. Ear tagging, Tattooing and branding
- Vaccination against diseases.
- For trimming hooves of animals that have grown out of shape.
- Injecting sick animals with drugs.
- For clinical examination to find out if on animal is sick e.g. Taking body temperature.
- For taking blood samples from animals for nursing animals especially stubborn cows.

Advantages of a crush.

- Can be used to serve / carry out a variety of farm operations unlike the dip, spray.
- It is cheap to construct especially when wood is used.
- It is easy to use / does not require skilled labour.

Disadvantages.

- Can not be used to handle very many animals at once.
- It is not durable especially if wood is not well preserved./treated.

Procedure.

Procedure of hand spraying of animals: use **BBBRH** for correct procedure

b) Spray race.

Is a farm structure designed to control external parasites like ticks, mites and biting flies on animals?

It is an enclosed space in which animals are exposed to spray delivered at high pressure through a system of well arranged nozzles/

In a spray race, animals walk through a confined area/race where pipes with nozzles at certain intervals and angles are fitted.

In the spray race, the acaricide (chemically)is pumped from the sump/reservoir and is forced to more along pipes at a high pressure.

- The spray chemical / acaricide emerge through nozzles which break it down into small droplets.
- The spray race is operated by use of power, diesel or petrol fuel or power take off shaft of tractor.
- The animals are allowed to walk through the race towards the drainage race in a liquid and fully covered with the acaricide.
- The discharged acaricide /used acaricide that drips from animals body drains back to the reservoir via filter pipes and is recirculated by the pump through the system

Stock management at the spray race / precaution taken when using spray race.

- Cattle / animals should be arranged in a single file as they enter the race.
- Animals should lift their tails as they go through the race so that the under tail wetting takes places.
- Young calves being sprayed for the 1st time can be encouraged to go through the race in a group.
- When adult cattle are being sprayed for the 1st time, they should be run through the race once or twice without being sprayed to accustom them to it.
- After spraying the remaining quantity of dirty spry wash should be pumped out into a fenced off pit and the unit should be cleaned thoroughly.

Advantages of using a spray race.

- It is cheaper to install than a dip talk.
- It uses a small quantity of acaricide
- The farmer is able to change the type of acaricide at every spraying without the expense of having to refill a large capacity farm.
- Many animals can be sprayed in a short time.
- Less labour is needed to operate a spry race e.g. one person can switch on and then drive the animals through the spray race.
- It can also be used to spray small animals such as goats and sheep.
- It can be used on calves and pregnant cows that are about to deliver since it causes fewer disturbances on to animals.
- Fresh acaricide is used always. This ensures good quality and effectiveness of the spray wash.
- It reduces wastage of acaricide.
- There is less risks of accidents during spraying than dips.

Disadvantages of spray race use.

- Nozzles can easily be blacked by dust in the spray even during wet season
- There are possibilities of certain parts of the animal's body not being covered by acaricide.
- Requires technical skills to operate the spray race
- It requires a reliable source of power to run the pump at the required speed.
- It is only economical with a very large herd.

The cattle Dip (Plunge dip)

This is a structure constructed basically for tick control. Here animals are totally submerged in the acaricide in the dip take.

There are 2 types of dips

- Machakos dip - for small animals
- Plunge dip - cattle

Capacity of most dips is 14000-22000 liters.

Structure of Dip diagram here

Functions of the components of the Dip (Features of Dip talk)

1) **Collecting yard:**
   This is where animals gather before the dipping process.
2) **Entrance race:**
   It is a narrow passage that allows animals to move to the foot bath in a line

3) **Foot bath:**

Is a depression located in the entrance race and contains water to wash the hooves of animals before they enter the dip talk.

4) **Swim bath/ Dip tank**

Holds the dip wash in which the animals swim its side should be raised above the ground to prevent spilling of acaricide as animals jump into dip tank

5) **Exit ramp**

This enables animals to climb out of the swim bath.

6) **Drainage race.**

This holds animals as they leave the swim bath so that the excess dip wash can drip off their bodies and return to the swim bath.

7) **The Roof;**

To reduce excessive evaporation of water from dip wash due to the sun's heat and to prevent dilution of dip wash by rain water.

8) **Waste pit / soak a way pit;**

Is a pit where sediments from the farm are damped?

9) **Splash Wall.**

To allow acaricide to get back to the swim bath especially after splashing to the walls /roof.

10) **Jump.**

Where animals jump to the swim bath

<u>Procedure of dipping animals</u>

- Assemble the animals in the collecting yard.
- Allow the animals to drink water before dipping starts.
- Check the level and concentration of the dip wash and replenish if necessary.
- Fill up the foot bath with clean water.
- Open the pipe that returns the dip wash from the drainage race to the tank
- Animals are allowed / forced to move through the entrance race in a single file and move into the swim bath where they are completely immersed in the dip wash.
- Animals then walk out of the swim bath using the exit ramp.
- They are held in the drainage race so that excess dip wash drains off their bodies.
- The 1st 10-20 animals to be dipped should be dipped again as they could have passed through the dip wash before it was well mixed.
- The animals are allowed to leave the drainage race.

Qtn Explain the factors considered when selecting the site for a dip tank

<u>Precautions that should be taken before and after dipping.</u>

- Animals should be watered first, should be given water for drinking as thirsty animals are likely to take the acaricide.
- Dipping should be done in the morning of a bright sunny day.
- Pregnant animals should not be dipped to avoid collapsing in the swim bath.
- Sick animals should not be dipped
- Do not dip on a rainy day because the acaricide can be washed off.
- Ensure the footbath is filled with water before dipping starts to avoid contaminating dip.

- Ensure the concentration of acaricide this should be done through replenishing
- Ensure uniform mixing of acaricide by running 5-7 animals before dipping.

Factors that may change / alter the concentration of the dip wash.

- Excess fouling and sedimentation
- Flooding
- Evaporation
- Leaking through poor construction / on poor soil
- Inefficient stirring / agitation.
- Prolonged use of dip wash
- Leaking roof leading to dilution of acaricide
- Weak concentration of acaricide
- Improper mixing of acaricide

Advantages of using the dip tank.

- Many animals dipped on a single day
- Dip wash can be used a number of times before it is discarded / used for so long
- The animals are fully covered by the dip wash which effectively control ticks on their bodies
- If well maintained, it is durable and can serve for many years.
- Require little labour to use
- It requires less technique skills to use than the spray race
- Spoilage of chemicals / acaricide is minimal
- It is cheaper to run in the long run.

Disadvantages of using dip tank

- Initial capital of installation is quite high for small scale farmers to afford
- Require some skilled labour to use e.g. When detecting construction and level after dipping
- Animals can get injured especially when level of dip wash falls below the lowest recommended level.
- It can not be used on claves, pregnant cows and sick animals.
- Dip wash can poison animals if poorly diluted or may not be effective if it is too dilute
- It is labour intensive and time consuming to empty and refill it.
- Diseases such as floor rot, foot and mouth can be introduced in the dip wash which affects other animals.
- It is not economical for farmers with few animals.

FARM BUILDINGS

These are important structures commonly found on farms

Examples of farm buildings:-

- Crop stores
- Farmers residential house
- Green house
- Farm offices
- Pigstry
- Calf pens
- Rabbit hatch

Benefits / importance of farm buildings.

- They provide comfort to humans and animals by acting as places of reluctance
- They protect animals from bad weather and attack by parasites and wild animals
- They are used to store farm produce / products e.g. maize grains, hides and skins
- They protect farm machinery from bad weather elements like sun, wind, rain.
- Farm buildings enables farmers to spend less on labour e.g. by reducing labour needed in drying of crop products.
- Farm buildings can be used in crop production to grow crops that can not withstand weather conditions e.g. green houses for planting roses,
- They protect vulnerable livestock e.g. poultry rabbits against thieves and predators which reduce stress and out puts.
- Some are used as office for management of farms hence increases efficiency.
- Farm buildings increase the quantity of farm produce e.g. yellow bananas and some other products are harvested in raw form and ripen in stores.
- They help to store farm produce when market prices are low so that they can sell when prices are high.
- Farm buildings increase real estate value of the farm.

Siting farm buildings.

(Selecting a suitable site for farm buildings)

Farm buildings should be sited in strategic areas if they have to play their beneficial roles. The factors considered include;

1) **Accessibility**
   Farm buildings should be sited close to main road. This enables farmer to transport farm produce to the market and bring in farm inputs from the market.
2) **Location**
   Should be sited in the center of the farm, this facilitates easy supervision of the whole farm since all parts of the farm are equally accessible to the farmer.
3) **Topography**
   Be located on high ground to avoid dampness especially during wet season to prevent sinking of the foundation.
4) **Soil type**
   Be sited on least productive areas of the farm (infertile soils) while production areas should be reserved for crop production.
5) **Drainage**
   Site should be well drained to prevent water logging. The site should be gently sloping for safe disposal of water after it has rained because they favour breeding of parasites.
6) **Water supply**
   Should be sited where there's easy access to a reliable source of water, e.g. tap, well for use at farm.
7) **Power supply**
   Where possible farm buildings should be sited near the source of power for easy processing of farm produce before being sold.
8) **Security**
   Buildings for vulnerable/sensitive enterprises like rabbits, birds etc should be sited near farmer's house of residence for easy supervision.

9) **Orientatio**n

Such that high noon **sunrays** should not directly hit into the building.

The best site should be in such a way that day scotching winds/sunrays should not be allowed into the building because they affect the feeding activities and cause stress to birds.

10) Panorama

The view of the surrounding area should be pleasant to the observer.

11) Future expansion

Since the farm is expected to keep growing and expanding, space should be left and reserved a side for future expansion.

FACTORS TO CONSIDER WHEN PLANNING AND DESIGNING FARM BUILDING.

- Purpose/use of the building e.g. design of crop shore should be different from that of the rabbit hatch or green house due to its intended use.
- **Construction and maintenance cost.**
  Farmer should use the materials depending on his income e.g. farmer cannot plan using expensive building materials like tiles when his limited cash.
- **Surrounding environment**
  E.g. in areas where there are strong winds, some walls in animal house should be raised up to roof.
- **Available constructional materials.**
  It's cheaper to use readily available materials than to transport them from far away.
- **Risks and uncertainties**
  E.g. outbreak of fire, thefts of produce for possibilities of fire outbreak, and an emergency door should be included.
- **Availability of labour for construction work.**
  It's important for the labour to consider whether there's skilled labour to build using certain materials e.g. tiles, concrete etc.
- **Possibilities for future expansion.**
  Consider possibilities for future adjustment on the buildings e.g. expanding it or modifying it so that it can be used for another.

FACTORS TOCONSIDER WHEN LAYING OUT FARM BUILDING

- **Relationship of building s to others.**
  Buildings with closely related functions should be sited near each other to maximize planning efficiency.
- **Flexibility of the building.**
  Buildings should be constructed in such away that they can be able to serve many purposes. E.g. Using a cattle barn as a milking parlour.
- **Possibilities for future expansion**
  An allowance of land should be left around each building so that in case of need to expand the enterprise, other buildings that are already set up a re not demolished.
- **Fire risks**
  Inflammable substance such as fuel, hay can catch fir easily and cause a lot of destruction. Therefore stores for such materials should be constructed at a reasonable distance away from other buildings.

- **Air pollution**
  Certain enterprises like poultry and piggery that are likely to produce a lot of foul smell or bad ordours should be sited down wind and at a distance away from farm offices and residential houses.
- **Building materials**
  Farmer has to select the most suitable materials depending on the kind of building to be erected and for how long it is intended to serve.

BUILDING MATERIALS

1. WOOD

In construction work, wood may be used as timber for poles, risks, rafters and trusses, making floors, ceilings, Furniture and facial boards, doors, windows etc.

Advantages of using wood ass building materials

- Wood is locally available in many parts of Uganda
- Wood is cheap to buy than concrete plastic.
- Wood is easy to shape into various forms using simple tools/does not require specials skills.
- Wood is a poor conductor of heat and electricity.
- Wood can easily withstand shock and vibrators.
- Wood is easy to constrict and dismantle.
- Wood is durable when properly treated.
- Wood is versatile i.e. can serve very many purposes.
- Wood is light material compared to metals.
- Wood has a good appearance.

Disadvantages of using wood

- Wood easily burns if not well protected from fire
- Wood is not strong like metals/concrete and can easily break if subjected to very heavy tasks/loads.
- Wood can easily be eaten by termites.
- Wood is susceptible to bad weather if not treated.
- Wood takes long to grow and become ready for use.
- Wood can easily develop some defects and can easily crack.

QTN. Give reasons why wood is considered to be a versatile material of construction at the farm?

2. CONCRETE

This is a mixture of sand, cement, aggregate and water in various proportions depending on the strength and type of work to be done.
Concrete is used for making blocks for building, for joining blocks, bricks and stones.

TABLE SHOWING TYPICAL CONCRETE MIXTURES

GRADE	TYPE OF CONCRETE	CEMENT	SAND	AGGREGATE	USE OF CONCRETE MIXTURE
1.	STRONG	1 part	1 ½	3 parts	Columns, walls, floors
2.	STARDARD	1 part	2 parts	4 parts	Foundation, floor, ceilings
3.	MEDIUM	1 part	2 ½ parts	5 parts	Foundations
4.	LEAN	1 part	3 parts	6 parts	Foundation and thick walls

NB

The greater the proportion of cement the stronger the concrete

- When mixing concrete, make sure that each aggregate is covered by cement.
- The strength of concrete will also depend on the methods of curing/covering hence concrete should not be exposed to the sun directly.
- Although concrete is strong in compression, it is weak in tension and therefore it must be reinforced with iron bars or steel rods which takes tensional forces.

3. BLOCKS

They are made of sand, concrete, murrum or sun dried clay or anti hill soils.

They may be molded by use of simple wooden moulds or by sophiscated moulds made of Galvanized steel.

4. **Bricks**

A brick is hard /well shaped pieces of barked clay/anti hill earth

Procedure of making Bricks

- Vegetation cover and a thin layer of top soil are scrapped off to expose clay.
- Clay, anti hill earth is mixed with water is worked well / pressed well to remove excess water.
- The materials are then left to ferment for a number of days in order for organic matter to decompose and form proper bonds with soil.
- It is then molded or shaped by putting it in a brick mould
- The brick should be dried under a shade to avoid cracking
- The bricks are then burnt in a brick kiln until they turn red to their strength and durability.
- Bricks are used for construction of walls and foundations.

5. **Plastics**

These are used in internal fitting such as water pipes, electricity pipes and fillers for insulations

Advantages of plastics

- It is a good insulator i.e. used in electric fitting
- It is cheap compared to mortar
- It is resistant to attack by weather conditions insects, fungi
- It requires no special treatment

- They are light in weight and size
- They do not rust

6. **mortar**
   Is the mixture of sand, and cement with water usually with a ration of 4:1.
   Mortar is used to bind brick together during construction.
   Mortar is used for plastering walls and finishing floors
7. **Metals.**
   Used in form of bars, metallic poles, pillars pipes steel rods for reinforcing concrete, Core netting etc depending on the purpose of the building
8. **Earth / soil**
   Commonly used on peasant farm houses in the farm. It is used to make foundations and walls used to make mud blocks and bricks. However, houses made of these materials are not permanent but can last longer if walls are coated with cement, sand and mortar,
9. **Stones**
   These are used to put up permanent structures especially to make their foundation, floors and walls stones are cheap to use but expensive if they are not locally available.
10. **Thatch**
    Used for roofing instead of corrugated iron sheets or tiles

Parts of Typical Building –draw the structure of the farm building

a) **Foundation**
   Should be erected on well drained area to avoid sinking the building.
   Foundation should be firm and is made using stoves, concrete and Damp proof course

Procedures of making the foundation.

- Measure the site using a measuring tape, string and pegs
- Clear a way the surface vegetation.
- Dig the site to the required depth i.e. 35cm wide and not less than 50cm deep
- Remove all the organic matter until you reach sub soil
- Mark the foundation with pegs in the ground
- Use the spirit level to check horizontal level of excreted area of the foundation.
- Throw broken stones, bricks into the excreted site
- Pour concrete on top into the site to make hard core start at one end
- Ram gently to avoid concrete from coming out
- Lay final thin layers of concrete to the level which provides good surface
- Allow it to set
- If the building is for livestock allow rough finish
- A damp proof course (DPC) is inserted 15cm above the ground level. This is to reduce water movement by capillarity into the wall

b) **Wall structure**
   The wall should be constructed in such away that it supports all vertical loads

c) **Roof structure**
   Made by timber, blocks, metals and grass

Features of the roof

- **Trusses.**
  These support the thatching material
- **Cross tie**
  Is the base of trusses?
- **Rafters**
  These are attached to the base to form a triangular structure
- **Struts**
  These are nailed diagonally onto the truss for attachment of the roofing materials
- Rafter batten / fascial board
  Holds the rafter in position
  NB. If the roof is to be made of grass or tiles, the rise or pitch should be high to lead the water run off easily and so increase the durability of the roof.

Structural requirements of farm building

a) Features of a good live stock house

- Floor made of concrete so that it is easy to clean and gently sloping so that urine can drain off easily
- It should have a roof to protect the animals from rain and sunshine.
- Walls should be high enough to protect animals from scotching winds and violent rains
- Walls should be strong, plastered to seal off crevices that can act as living places for parasites
- Animals house should be large enough in order to accommodate the animals
- A large space should be left between the wall tops and the roof for good ventilation
- Should have enough light system in order for animals to see each other which makes them active
- Should have feed trough where water is put for feeding by animals
- Should have water trough where water is put for draining by animals
- Should have an adjacent store where the equipments such as feeds, drugs equipments are kept

b) Features of a good crop store

- Should have leak proof to avoid rain and sunshine from destroying crop produce
- Should have smooth walls to prevent movement of pests on the walls where pests can not hide.
- Should have strong lockable doors
- Should have strong foundation raised to prevent/avoid dampness
- Should be well ventilated to allow easy air circulation
- Should have an supervisions floor for easy cleaning
- Should be in close proximity to released structures
- Should be large enough with races / stalls to accommodate the produce
- Should have pillars and posts that care rat guards or deflectors to prevent rodents from destroying the crop produce
- Should be well fitted with racks so that crops should not directly be placed on the ground

Assignment 4:

a) Outline the characteristics of:-
   i a good crop store

ii a good calf pen

b) Explain the considerations put in place before choosing a site for a building at the farm
c) What do you understand by farm lay out
d) What do you consider when planning a lay out of a farm?

FARM WATER SUPPLY

Water is essential for the smooth running of farm activities. Crop, livestock and humans can not survive without water

Importance of water on the farm

- Water is used for drinking both man and livestock
- Water is used for mixing feeds like when feeding sows with maize brand, it is 1st mixed with water
- Water is solvent for mixing various solutions suspensions or even emulsions of farm chemicals e.g. pesticides, acaricide etc.
- Water acts as a coolant because the evaporation of water from a source leads to dispersion of latent heat of vaporization.
- Water is used for aquaculture/fish farming is carried out in ponds with water.
- Water is used for irrigation especially in drought periods to enable plants meet their water needs.
- Water is used as a source of power directly as a water mill for grinding cereals or conversion of hydro electric power.
- Water can also be used for washing around houses, floors, walls etc.
- Water is used for cleaning of utensils, farm tools and equipments.
- Water is used for preserving perishable farm products such as vegetables, fruits etc.
- Water is used for cooling farm machinery e.g. tractors, transport vehicles and millers.

Problems associated with water on the farm.

- Loss of soil fertility as a result of washing a way of the fertile top soil/soil erosion and leaching.
- Stagnant water can act as a breeding place for parasites e.g. liver flukes and bilhazia worms and some vectors of disease causing organisms like mosquitoes and snails.
- Contaminated water can be a carrier of human disease such as typhoid and cholera.
- When water is excessive in the soil, it interferes with plant growth and development.
- Useful soil living organisms e.g. Nitrogen fixers and decomposers cannot live in water logged areas/soils because such areas lack air that is needed for respiration.
- Some livestock at the farm may drown in water bodies e.g. ponds, wells that are deep.

However, water shortage on the farm may be due to:

- Inadequate supply of water to the farm
- Deforestation which increases soil erosion, filtration of water bodies that in turn interfere with the water cycle.
- Drainage e.g. sinking of boreholes which lower the water table.
- Pollution of water sources which may make water unsafe for farm purposes.

Sources of water at the farm

Water may be obtained at the farm from:-

- Natural precipitation/rainfall
- Surface water bodies like streams, rivers, lakes, ponds and swamps.
- Underground water sources- when it rains, water sinks into the soil, soon meets an impervious layer of soil/roc k it accumulates there, forming underground water.
- Underground water can be obtained from the soil through:-
- Springs
- Boreholes/wells
- Dams
- Weirs

Water storage

- Water storage on the farm is necessary in order to keep it safe from contamination, avoid water wastages, to use it during time of shortages especially during the dry seasons.

  Water can be stored in the following ways:-

a) By trapping rain water

- Farmers can trap rain water from roofs of farm buildings and store it in containers, drums, barrels, tanks and reservoirs.

1. Reservoirs

These are open water storage structure are made to trap and retain runoff water from roofs, compounds etc.

2. Valley dams

These are open water storage structures that are dug up to trap and runoff water from a catchment area.

3. Drums, barrels

4. Tanks draw diagrams of:

(i) Roof tanks -

(ii) Under ground tank

(iii) Overhead tank

Is usually made of galvanized steel to prevent rusting and is usually raised off the ground to ease water floor out of the tank due to gravity.

Water is pumped in through the tap of the tank under gravity. There's usually an overflow pipe to allow excess water to flow out of the tank.

(iv) Valley tank

Made with a silt trap from the pond a long its flour from the streams or along an overflow of rain. Silt trap prevents excess sedimentation of the stream.

(v)Earth dam

A dam is a well/bank built to keep back or reduce water flow and store much water.

(vi) Weir

Is a structural device designed to raise the water level of a stream or river to a point above which water begins to flow?

A weir may be made from loose stones or logs held together by a wire net.

Vertical section of an earth dam

FARM WATER TREATMENT

They include:-

- **Boiling: -** This kills germs especially if the water is to be drunk by the farmer should be boiled to avoid water borne diseases.
- **Filtration:-**
  Filtering removes foreign materials. This can be done using sand filter.
- **Storing water for long periods of time:-**
  This enables and allows sediments to settle at bottom while clean water can be decanted into another container.
  Storing water for so long helps to kill some germs and parasites like Bilhazia worms and liver flukes.
- **Addition of chemicals:-**
  Chemicals such as chlorine, sodium hypochlorite are used to kill bacterial and snails to control liver flukes.
- **Exposing water to sunlight:-**
  Ultra violet rays in sunlight can kill germs in water when the water is left to stand in an open container such as a trough.

Maintenance of water supply to the farm

- The area around the water sources should be kept under grass cover to protect if from erosion. This is because the grasses trap soil that would otherwise be carried into the water source and silt it up.
- Water sources such as wells, ponds and springs should be fenced to keep animal a way and avoid contamination of water.
- Water tanks, walls, pipes and all supporting structures associated with water supply should be kept clean.
- Ponds must be desilted when necessary and water vegetation be removed.
- Grass planted around water sources should be kept short by slashing from time to time.
- Overhead tanks, roof tanks should be covered to avoid contamination from annual droppings dead annuals and dirt from winds.
- Drainage channels should be dug around water sources to carry away dirty water.
- Ensuring that pumps and pipelines functions properly by regularly servicing them. E.g. Tank leakages should be repaired as they lead to wastage of water.

GUIDING QUESTIONS

1a) Explain why water is of great importance on a farm
b) State the problems that are likely to be caused by water on a farm.
2a) Outline the sources of water used on the farm
b) How can water intend for latter use be stored on the farm.
c) Outline the mentainance requirements of water storage container.
3a) Describe how river water can be used in irrigating crop fields
b) Suggest the benefits of irrigation.

AGRICULTURE MECHANISATION

This refers to the use of mechanical aids or machines to carryout agricultural activities.

It is one of the technology inputs that facilitate increased agricultural production. Agriculture mechanization improves human labour productivity by reducing the burden and drudgery associated with farm work. Human supply power for operating simple tools e.g. hand sprayers, drenching guns, mortars, hay cutting machines, chain saws, while animals such as donkeys, horses supply power for ploughing and transporting materials.

Advantages / benefits of Agriculture Mechanization.

- It increases farm out put by putting to use land that is idle due to scarcity of human labour.
- Mechanization simplifies difficult farm activities that can not be easily accomplishes using manual labour such as terracing, reclaiming forested land and draining swampy areas.
- Mechanization reduces human drudgery since most farm activities are unpleasant, labour demanding and quiet tiresome carried out manually. When these activities, are mechanized human drudgery is reduced.
- Mechanization speeds up the rate of work. It increases the rate of work which enables farmers to complete farm jobs.
- Mechanization improves the properties of the soil. Use of machines to carry out sub soiling secondary tillage helps to improve soil physical properties such as water infiltration
- Mechanization may help to overcome labour "bottlenecks" during growing seasons and in areas where the land to labour ration is high.
- Mechanization helps to provide adequate alternative working conductions so as to recruit a satisfactory caliber of workers in agriculture operations.
- Mechanization may allow a better combination of enterprises on a farm because their will be enough time to engage in different enterprises.
- Mechanization improves quality of produce due to better uniformity.

LIMITATIONS /DISADVANTAGES OF AGRICULTURE MECHANISATION

Disadvantages of Agriculture mechanization limitations of agriculture mechanization

- **Presence of small pieces of land/ fragmentation**
  Majority of farmers in Uganda have small pieces of land which can not be easily mechanized.
- **Inadequate capital**
  To buy machines, most farmers practice substance farming, some farming activities do not require use of machines/ can not be mechanized e.g. harvesting coffee, cotton, tobacco, bananas, sugarcane, tea, pineapples, orange, mangoes
- **Unemployment**
  Especially in areas where there is no other sources of employment
- **Insufficient work on the farm**
  Machines tend to lie idle for most parts of the year when there is no work on the farm which makes them to depreciate faster.
- **Lack of enough spare parts on the local market.**
  Once machines break down, they are just discarding even when they could still do some work if repaired.

- **Topography in some areas.**
  Some areas in Uganda are too steep to be mechanized e.g. Kisoro, Kabale, where tractors machines can not work.
- **Inadequate skilled labour**.
  To operate, repair and maintain machinery, this accelerates rate of machines depleciate.
- **Inadequate servicing**
  and maintenance facilitates untrained and poorly trained man power lower the life span of machines as this which machines as this inadequacy in machinery utilization increase the total cost of production
- **Inadequate extension services**.
  Farmers lack experts to guide them on the kind of machinery to buy to train them on how to maintain machines and how to optimally use them
- **Political instability in some areas.**
  This has mad ea fail mechanization impossible in some areas as farms are vandalized and machines taken away.
- **Presence of cheaper alternatives.**
  Sources of power in some areas there is plenty of human and animals power which are cheaper than machines
- **Conservativeness of some farmers**
  Some farmers are adamant to change their traditional beliefs and values. They can only change their life styles if the new technologies are within the range of their aspiration and expectations

Farm power sources.

Developing countries are encouraging their farmers to change from traditional methods of farming and adopt modern farming technologies so as to boost production.
Modern farming requires better sources of power when doing farm activities
They include;

- Hand power / human power
- Animal power
- Wind power
- Electric power
- Solar power
- Engine power

a) Human / Hand power

Involves use of manual labour to perform farm activities e.g. Land clearing, digging, planting, weeding, spraying and harvesting.

Advantages of human power

- Human power is readily available to farmers
- It is cheaper than other sources of power especially in highly populated areas.
- It can be easily adjusted to balance with the amount of work available on the farm.
- It does not require technical skills
- It is not affected by topography

Disadvantages of human/manual power

- Rate of doing work is very low making it difficult to complete certain farm activities on time.
- Sometimes the supply of human power may be inadequate to meet the demand.
- Human power lacks necessary skills which may not be able to cope with new production programs.
- Human efficiency declines as his work per day increases.
- It can not cope with large aches of land.
- The health condition of human labour influences work to be done.

b) **ANIMAL POWER**

This is power provided by animals such as oxen, buffalos, bullocks, donkeys, horses, camels, etc. Examples of farm activities done using animal power.

- Transporting materials, agric produce, water, splits.
- Ploughing
- Planting
- Weeding

Factors that influence power output from animals

- Age-matinee animals produce high power/young ones
- Food intake-energy is from food eaten
- Breed & type of animal – use of local breeds that are hardy
- Training given to the animal
- Yoke used for hitching
- Animal handling by the operation
- Health status of animal
- Climate conditions

Advantage of animal power

- It is cheaper to use on small holder farms than engine power.
- It can cope with large pieces of land.
- Animals can even operate well where land is fragmented
- Animals power is multi-purpose, e.g. Can supply sung, urine, draft power and even meat production.
- Does not require highly skilled labour to operate than engine power.

Disadvantages of animal power

- Animals get tied with on a short time, especially during hot weather.
- It might become costly to maintain animal's health especially when they become sick, to feed them etc.
- Animals woke at a lower rate than engine power e.g. animals would take longer time to cultivate an area than in cultivated by tractor in a single day
- They require land for grazing
- Animal power requires training by skilled personnel

c) Wind power

Wind power provides power that can be used to:-

- Carry out winnowing or separate rubbish from the grain of crops eg. Beans, simsim, ground nuts, rice, sorghum, millet
- Pump water from wells into over head tanks
- Operate generators for production of electricity

NB. Wind power can be tapped using a machine called wind will

Advantages of wind power.

- It is free of charge
- It is easy to maintain the equipment, since there is no need to fuel it.
- It requires no skilled labour

Disadvantages of wind power

- It's strength is unreliable i.e. its direction, strengths and availability are unpredictable
- Initial cost of purchasing a wind will be high
- Availability of wind power is not assured as it might not blow when urgently needed.

d) Electric power

This kind of power can be obtained from electricity supply / generator/battery.

It can be used to operate refrigerators, incubators, used in the brooder, milking machines, water heaters used to run water pumps, guiding mills.

Advantages of electric power.

- It has a wide range of applications on the farm i.e. can be used to operate many farm activities.
- It can easily be converted to other forms of power e.g. mechanical, heat, sound, light.

e) Solar power

This is obtained from the sun; it is used mostly by green plants to make their own food.

It can be used directly by farmers to dry their crop products.

Advantages of solar power.

- Solar energy is free of charge and there is no maintenance costs incurred
- Solar power does not cause pollution as it is the case with engine power which release smoke into the environment.

Disadvantages of solar power.

- It is expensive to purchase and install the machines for trapping and storing solar power.
- The intensity of solar power in the rainy season may be low to do work.

f) Engine power

An engine converts the chemical energy in fuel (Diesel + petrol) into mechanical energy.

Farm tractors, classification and use

Uses of tractors.

- To pull farm implements like disc plough Mould board Plough when connected to the draw bar
- Tractors are used to pump water on the farm
- Tractors provide transport on the farm by transporting farm products when they pull a trailer.
- Tractors drive other machines
- Tractors are used to operate a milking machine
- Tractors are used to drive a grinding mill for grinding grain such as maize, millet.

Classification of farm tractors.

Farm tractors are classified according to:-

- According to the power the tractor quarters i.e. i) small tractors-25HP ii) medium tractor 25HP-50, iii) Large -50

- According to use of tractor- tractor-garden tractors, industrial tractors, tools heeled/ walk type
- According to the way tractors / grip is a achieved i.e.

i. Crawler type does not have wheels, has a crawler/chain used for land clearing soil conservation.
ii. Half wheel($^1/_2$ crawler type) has both wheels and crawler tyres -front has wheels, ream, chains
iii. Wheel type tractors. Have rubber tyres at the front behind(rear)
iv. General purpose type.

COMPONENTS OF TRACTOR ENGINE.

The 4-stroke engine structure -**diagram**

a) Cylinder

This is a hollow space /chamber where fuel is burnt to produce power. The higher the number of cylinder an engine has, the more the power it produces.

Diagram here.....

b) Cylinder head

This seals off the top of the cylinder. Normally the cylinder head gasket is placed between the cylinder head and cylinder block to create a tight seal.

c) Piston

It moves up and down within the cylinder during the power production process.

- It is responsible for efficient compression of the fuel air mixture in petrol engine/Air in diesel equipment.
- It transmits power produced in the cylinder to the crank shaft.
- It helps in lubrication by scooping oil out of the sump and splashes it upwards.
- It helps to expel exhaust gases/fumes from the cylinder during exhaust stroke.
- It draws the fuel air mixture into the cylinder during induction stroke.

Diagram here.....

Parts of the piston

- **Compression Ring**

  They ensure efficient compression of fuel air mixture/ prevent leakage / fuel

  Diagram here.....
- **Oil rings.**

  These ensure efficient lubrication /distribution of oil onto the cylinder walls and piston head.
- **Piston rod /Connecting Rod**
- Transmit power from cylinder to crank shaft connects piston to crank shaft.

d) Crank shaft.

It rotates and helps the piston to move up and down it rotates and makes the piston to move up and down.

It transmits power from the engine to the fly wheel crank shaft converts linear mention of the piston into rotary montion (power) is the transmitted to the fly wheel .

e) Fly wheel.

- Maintains uniform speed of the engine by carrying crank shaft through those intervals when it is not receiving power from piston.
- It receives power from the crank shaft and transmits it to the clutch assembly.

- It assists in the start of the engine since as gears on the mortar rotate by wheel is turned and this durries/ rotates crank shaft which starts the engine**.**

f) <u>Valves.</u>

- Inlet valve -allows entry of fuel air in petrol engine/air in diesel engine
- Outlet valve -allows expulsion of exhaust gears out of cylinder

g) <u>Cam shaft</u>

It bears cams which operate opening and closing of valves.

<u>POWER PRODUCTION IN 4-STROKE ENGINE</u>

These are engines in which the crank shaft valves to revolutions followed by 4 strokes of the piston.

The strokes include;

- Induction/intake
- Compression
- Power/ignition
- Exhaust.

<u>4-strokes in petrol engine (spark ignition engines)</u>

a) Induction /intake stroke

During this stroke the following occurs;

- The inlet valve opens as outlet closes
- The piston moves down wards to BDC
- The fuel air mixture is drawn in the cylinder due to a partial vacuum created inside the cylinder
- The inlet valve closes when the piston reaches BDC as shown below.

Diagram here.....

b) <u>Compression stroke</u>

During the compression stroke the following occurs;

- The piston moves upwards from BDC to TDC.
- Both inlets and outlet valve closed
- Fuel air mixture is compressed to a small fraction of its original volume. Due to compression of the temperature of the fuel air mixture rises
- This stroke ends when the piston reaches the TDC as shown below.
  Diagram here.....

c) Power stroke / ignition stroke

During this stroke the following occurs;

- Both inlet and outlet valves are close
- A spark is produced by spark plug which ignites or burns compressed fuel air mixture to produce power,
- Power produced is transmitted to the crank shaft by the down ward movement of the piston
- The stroke ends when the piston reaches BDC.

FIRING ORDER.

This is the order in which ignition occurs in different cylinders . in 4 stroke engines with cylinders numbered 1-4 from front to end the firing order can be:

1.3.4.2

1.2.4.3.

Diagram showing power stroke.

d) Exhaust stroke

During this stroke, the following occurs.

- Inlets valve closes while outlet valve opens
- Piston moves upwards.
- Burnt /Exhaust fumes are expelled through expelled through outlet valves by the upward movement of the piston
- The stroke ends when the piston reaches the TDC.

NB A Stroke is the piston movement from TDC to BDC and vice versa

Diagram showing exhaust stroke

Four stroke cycles in Diesel engines (compression ignition engine).

In diesel engines /compression ignition engine.

- During induction stroke; only air enters the cylinder through the inlet valves
- During compression stroke only air is compressed in the ratio of 16:
- During power stroke, fine diesel sprays are injected into the cylinder by fuel injector hit hot compressed air which ignites it.
- The other events are similar as those in petrol engines

Advantages of 4 strokes engines

- They are efficient in fuel utilization than 2 stroke engines
- They produce a lot of power and can be used to operate heavy duty machines
- They have bigger crank cases which are heavy in order to absorb vibrations of the engine.
- They are more frequently cooled mostly by water and so better than 2 strokes engines.
- They can do a wider variety of jobs than 2 stroke engines.

Disadvantages of 4-stroke engines.

- The initial and maintenance costs are vey high.
- They require more skills in operating than the 2 stroke engines
- They require more skills in operating them than 2 stroke engines
- They are hard even to use in hilly areas as 2 strokes are even used in hilly areas.

Guiding questions.

1. a) Describe how a 4 stroke petrol engine produces power.

b) Give 4 advantages and disadvantages of using 4 stroke engines

2 with the aid of illustrations show how 4 stroke cycle petrol engines produces power.

b) Give the differences between petrol and diesel engines.

DIFFERENCES BETWEEN COMPRESSION IGNITION AND SPARK IGNITION ENGINES

COMPRESSION IGNITION ENGINES(DIESEL)	SPARK IGNITION ENGINES (PETROL)
▪ Uses Diesel as source of fuel	▪ Uses petrol fuel
▪ No spark produced(have no spark plug)	▪ Produces a spark because they have spark plug
▪ Can operate without a battery	▪ A battery is necessary
▪ Have high compression ratio of about 16:1-20:1	▪ Have a low compression ratio of about 7-8:1
▪ Have an injector pump	▪ Have a carburettor
▪ They are heavier in weight hence produce a lot of power	▪ They are light in weight hence produce less power
▪ Produce more smoke & a lot of noise when running	▪ Produce little smoke & less noise when running
▪ Easier to start due to fewer starting problems	▪ Has more starting problems
▪ Air only is compressed during compression stroke	▪ Fuel an mixture compressed during compression stroke.

ENGINE SYSTEMS

Tractor engine system include:-

- Air supply
- Fuel system
- Electric system
- Lubrication system
- Cooling system
- Transmission system

THE AIR SUPPLY SYSTEM

The purpose of the air supply is to provide clean air to the engine.

There are 2 types of air cleaner's i.e.

- Oil bath type/wet type
- Dry air cleaner /Dry type

NB .There is need of air cleaner because atmosphere air contains foreign particles such as dust which would / can cause excessive wear and blockages of engines if they were allowed to enter into the engine. Therefore cleaning of air before it enters the engine is done by the air cleaner or air filter.

The oil bath / wet type air cleaner.

Components include;-

- Dome Stabilizer Vanes Filter element Per-cleaner
- Central pipe Sediment bowl/oil bath

Diagram here.....

Mechanism of wet type air cleaner

- When engine is in operation especially the field a lot of dust is known to mix with air
- In coming air enters the pre-cleaner through its inlets
- In the pre-cleaner air meets the valves / the stabilizer which cause it to swirl

- As air swirls, heavier dust/big dust particles are thrown out of air flow outside through the ejection slots out of the pre-cleaner.
- Air containing small particles of dust then flows through /is carried down through the central pipe to the sediment bowl
- In the sediment bowl, there is oil which retains particle of soil /dust that comes along with air.
- Air then flows to the filter element where there is further cleaning of air to help trap oily particles that were not trapped by oil in the sediment bowl
- All the trapped materials eventually settle at the bottom of oil in the sediment bowl
- In the filter element the remaining foreign materials are trapped here / retrained.
- From the filter element, clean air flows into the engine carburetor.

Maintenance of oil bath air cleaner

- Removing trash, from the air valves
- Washing the filter element with paraffin/petrol to remove trapped dirt
- Check the sediment bowl, remove oil if dirty, refill with recommended type of oil
- Empty and replace the oil in the cup if it is dirty
- Filter element should be periodically replaced with new one

Dry type air cleaner

This type does not contain an oil bath but uses a replaceable/ disposable element which allows foreign materials / particles to be trapped leaving clean air to flow into the engine.
The element can be cleaned by blowing air at high pressure through it.
It can be replaced after the service interval recommended by the manufacturer

FUEL SYSTEM OF DIESEL ENGINE

- Components
- Fuel tank
- Sediment bowl
- Lift pump
- Fuel filter
- Injector pump
- Injector

Diagram here.....

Functions of parts

- **Tank**
  Serves as store for fuel
- **Sediment bowl**
  Indicates whether fuel is clean/dirty
  Removes /retains large particles of dust in fuel
- **Fuel lift pump**
  It pumps fuel at high pressure to injector pump
- **Fuel filters**
  It cleans fuel (Diesel) to avoid blocking injector pump
- **Injector pump**
  Injects correct amount of Diesel fuel into the cylinder
- **Injectors/Atomizes**
  Converts liquid diesel fuel into a fine spray (Atomizes Diesel)
  Introduces atomized fuel into the cylinder

Operation of fuel Diesel system

- Fuel from the tank flows by gravity to the sediment bowl.
- In the sediment bowl large particles of foreign materials are retained and then fuel flows to the fuel if lift pump.
- In the lift pump, Diesel is pumped a high pressure to the injector pump
- But this is 1st through the fuel filters which remove all foreign materials before it is subjected to high pressure and sent to injectors.
- The injectors atomize Diesel and then inject it into the cylinder at the end of the compression stroke where it meets with hot compressed air and later burns.

Mentainance of Diesel fuel system

- Sediment bowl should be removed and cleaned
- Clean or replace fuel filters according to manufacturer
- Keep the injector pump clean /service it regularly
- Injectors should be replaced when worn out
- The cap of tame should be firmly closed to avoid contamination of fuel

FUEL SYSTEM OF PETROL ENGINE

Components include

- Carburetor
- Tank
- Fuel filter
- Lift pump
- Sediment bowl

Diagram here.....

Operation mechanism of petrol fuel system.

- Petrol fuel from the tame flows by gravity to the sediment bowl
- Big soil/dust particles that move along with fuel are retained in the sediment bowl
- Fuel are retained in the sediment bowl
- Fuel flows to the fuel filters which filter fuel to remove other particles to make fuel clean
- Fuel from the fuel filters flows to the lift pump.
  Here fuel is pumped at high pressure to the carburetor.
- In the carburetor, fuel is mixed with air (vaporized)in right proportion and is atomized

Functions of the parts

- **Tank**

It stores fuel

- **Sediment bowl**

It retains large dust particles in fuel

- **Lift pump**

It pumps fuel to carburetor

Maintains regular supply of fuel to carburetor

- **Fuel filter**

Remove dust from fuel

Carburetor
It breaks fuels (petrol into tiny fine droplets Atomizes petrol fuel)
Mixes fuel and air to make fuel air mixture (vaporizes fuel)
Supplies the engine cylinder with right quantity of fuel air mixture.

Maintenance of petrol fuel system.

- Never refill the fuel tank when engine is running
- Make sure that the flitter cap is firmly closed to prevent dirt and contamination of fuel
- Sediment bowl should be removed and cleaned, replace the strainer in the sediment bowl if it is damaged
- Replace worn out lift pump
- Fuel filters should be cleaned / replaced following manufacturers instruction.
- Float chamber should be cleaned regularly.
- Adjust the throttle valves
- Moving parts should be lubricated like around venturi.

THE COOLING SYSTEM
Much heat is produced when an engine is running due to burning of fuel in the cylinder. Therefore it's necessary to have the cooling system to keep the engine temperature correct because if the temperatures are left high, a lot of damages, effects may occur to the engine.
These are to be discussed latter
Types of cooling system include,

- Air cooling system(small engine)
- Water cooling system

Air cooling system
This type of engine is cooled by air and is not extensively used in Agriculture production but rather confined to small machine
X-tics of air cooled engine

- Are small in size
- They have fins
- They are light in weight because have no radiator
- They are simple in their construction

Disadvantages of air cooled engine

- They get heated quickly and hence less heavy lubricating oils
- They do not get cooled easily

WATER COOLING SYSTEM
Components include;

- Fan
- Radiator
- Fan belt
- Impeller/ water pump
- Pressure cap
- Thermostat
- Water jackets
- Water horses

Diagram here.....

FUNCTIONS OF THE PARTS.

- **Radiator**
  It exposes a large cooling area so that hot water from the engine can be cooled.
- **Water Jackets**
  It is an area surrounding cylinders in which water circulates
- **Water pump/impeller**
  Pumps water within the cooling system
- **Fan**
  Draws/blows used air towards the Radiator so as to facilitates rapid cooling
- **Fan Belt**
  This drives the water pump that pumps water
- **Temperature gauge**
  This indicates the temperatures of the engine
- **Thermostat**
  This controls the temperature of the engine ie it has a valve which closes when water temperatures are low/cold, and valve open when temperature are high allow water flow to the Radiator for Cooling.

OPERATION MECHANISM OF WATER COOLING SYSTEM

- When the engine is switched on, power production around the cylinders, heat is produced as a result of burning fuel.
- The water pump driven by the fan belt, pump water at a high pressure to the around the cylinders.
- Water around the cylinders absorbs the heat and water temperature increases i.e. becomes hot.
- Continuous pumping of water to cylinders occurs cold water meets hot water,hot water when it absorbs heat becomes less dense and rises upwards around the water jackets and is replaced by cold water.
- The thermostat valves detects the temperature of this water, if temperature are high above 80 °c then the thermostat valves opens allowing hot water to flow to the Radiator.
- In the Radiator, air blown by the fan, cools the water that was hot and this water cools /heat is dispersed by cold air blown by the fan through the cooling fins of the radiator grills.
- Cold water in the radiator is again pumped by the impellor to the cylinder and the process continues.

Advantages of using water in cooling system

- It has a high specific heat capacity that enables it to absorb heat easily
- It is readily available in many areas
- It circulates freely at all temperatures between the freezing and boiling. Compared to other liquids.

Maintenance of the water cooling system

- Check the water level in the radiator before a day work and top up with clean water
- Remove /clean the radiator grill/tubes to allow efficient passage of air for cooling.
- Water in Radiator can be removed especially when it becomes dirty

- Radiator should be drained and cleaned periodically(after every 300 hours of work as recommended by the manufacturer)
- Check condition of fan regularly, replace the fan if blades are broken
- Make sure that fan belt is set at correct tension ad replace if worn out
- Grease the water pump regularly
- Horse pipes should be tightly fixed if broken they should be replaced
- Radiator cap should be tightly placed to avoid being burnt by steam if it opens when engine is running
- Sealing off radiator leakage points
- Ensure water horses are not leaking.

Causes of over heating in the engine

- Loose fan belt
- Leaking radiator
- Blocked radiator tubes/fins
- Broken fan
- Fan belt stack
- Low water level in the radiator
- Thermostat stack
- Broken impeller

Effects of over heating in the engine

- High fuel consumption
- Dilution and contamination of oil
- Burning of the valves
- Pre-ignition
- Excessive tear and wear of engine parts
- Loss of engine power
- Cracking of the cylinder, cylinder head, etc
- Engine knocking

THE LUBRICATION SYSTEM

This system supplies oil to all parts of engine where dangerous friction is likely to occur.
Components of Lubrication system

- Oil sump
- Oil filter
- Oil pump
- Oil ways ignition
- Oil pressure indicators
- Oil gauge

Functions of the mayor components

Oil sump

It is a reservoir of oil; it is where oil returns after circulating through the oil ways/ galleries

Oil filter.

Removes foreign particles from oil before it is recycled through oil ways.

Oil pump,

Pumps oil around the engine

Oil ways/Galleries

It serves as the passage of oil to all parts of the engine that need to be lubricated

Oil pressure indicators

These warn the operator in case a blockage occurs in the lubrication system which prevents oil to circulate in the engine even to areas.

It is not meant to flow to.

Oil gauge /dip stick

Shows the oil level in the sump oil level

Is determined by withdrawing the dip stick and noting how low the oil appears on the dip stick

Enables some one to examine the condition of oil. If it is very dark and thin, it should be drained and replaced with fresh oil of the same grade/number (SAE Number)

Lubricants.

A lubricant is something that reduces /minimizes friction between two moving surfaces in the machines lubricants commonly used in engine are:-

- Grease
- oil

Functions of lubricants

- They reduce function between moving parts thus the life span of engine
- They cool the engine by conducting a way hat produced by function from moving parts
- They act as a seal between piston and cylinder walls and this helps to improve on engine efficiency.
- They clean metal surface by washing a way and trapping dirt, foot, dust and small metal particles that clip off moving parts during operation.
- They prevent rusting of metal surface
- They act as shock absorber, e.g. they absorb shock that would occur in bearings
- Lubricants absorbs noise of engine

Parts of engine where lubricants can be used;

- Piston
- Gear box
- Cylinder
- Brake system
- Differential unit
- Oil bath/sediment.

PROPERTIES OF LUBRICANTS

- Should have low velocity i.e. velocity is a half of liquid to flow
- Should have a good body i.e. thick enough to prevent contrast between moving surface
- Oiliness i.e. smooth and slippery
- Should have a good film strength in order to resist high pressure
- It should have detergents i.e. should have substance that have cleaning properties.
- Should have a high relative density

CONTAMINATIONS OF OIL

These are substances which make oil dirty and are not part of oil. They include,

- Soil and dust
- Metallic particles

- Fuel
- Acids formed when oil decomposes
- Paint
- Water
- Carbon deposits in Tank

Types of Lubrication system

- Pressure feed /force feed lubrication system.
- Oil mist/petrol lubrication system
- Splash feed lubrication system.

a) Pressure feed / force feed system.

Its commonly used in bigger engines e.g. 4 stroke type.

In this system Lubricating oil is forced between the moving parts by a pump immersed in the sump by pressure. The oil pump suck oil from the sump, forces it through a filter, oil lines and around the cylinder block, pistons, piston rods, cam shaft, crank shaft, valves and bearing.

After circulating to all these parts, it drips back to the sump.

Diagram here....

b) Splash feed lubrication system.

Here lubricating oil is splashed to the moving engine parts by a scoop fixed on the bottom side of the connecting rod of a piston.

This type is inefficient as some parts of the engine are not well lubricated especially when the oil level in the sump falls below the level where the scoop can reach.

c) **Petrol / oil mist lubrication system**

This is used in small cylinder engines e.g. 2 stroke engines where lubricating oil is mixed with petrol in the tank

Changing engine oil

Engine oil should be checked regularly using a dip stick to determine its conditions and level in the sump.

A dip stick is used to achieve this.

Steps followed when checking engine oil

(Procedure)

- Clean the area around the dip stick
- Withdraw the dip stick
- Clean the dip stick with a clean white paper/ cloth
- Replace the dip stick in its piston
- Withdraw it again
- Hold it almost horizontally and take readings
- Examine the condition of the oil including, leveling, thickness, colour etc
- If oil has become very dark it is necessary to drain it and replace with new engine oil

Maintenance of lubrication system.

- Check the level of oil regularly and add if it is low
- Check the condition of oil and draw it, replace with new engine oil if contaminated
- Use correct grade of oil to engine eg SAESO-SAESO as lower SAE numbers are thin oils used in small engine.
- Oil filters should be replaced regularly following the manufacturers instructions .
- Seal off any leakages in the systems to prevent loss of engine oil.

- Ensure proper functioning of the oil pump.
- Ensure that the filter cap is tightly closed.

TRANSMISSION SYSTEM

This system transmits/transfers power produced in the engine cylinder to the rear wheels and other parts of the engine.

Components of the Transmission system.

- Gear box ,Clutch assembly ,Differential
- Wheel and tyres ,P.T.O ,Final drive
-

a) Clutch assembly

- To disconnect and connect the engine from the rest of transmission system when selecting a suitable gear for the operation.
- To allow gradual transfer of engine power to the rear wheels so that the drive can take off smoothly
- To all transfer of power from the engine to live the P.T.O Shaft.

b) Gear Box

Metallic box containing a range of gear with different diameters and numbers of teeth which can be interlocked by means of gear level to give different power outputs.

Functions of gear box

- To adjust the speed of engine crank shaft to the speed at which the tractor is required to move when carrying out farm operations.
- To allow the tractor to be moved in reserved /backward direction whenever necessary
- To enable the tractor operate to adjust the pulling power output at the rear wheels to suit the farm operation being done.
- To enable the operation to stop the tractor without stopping/switching off the engine / keeping the foot pressed on the clutch pedal
- To provide a number of gears ratios that enables the tractor to run at different speeds.

c) Differential

This consists of gears that make it possible for rear wheels to move at different speeds thus enabling the tractor to turn or negotiate a corner.

Functions of differential

- To change the direction of power through right angles so that power is delivered to rear wheel.
- To allow the rear wheels move or run at different speeds when going round corner.
- To adjust / reduce the speed of the drive further so that the operator works at a slower speed than the engine speed.

d) Wheels and tyres - for propulsion

These receive power from the engine via the differential front wheels on tractor are mainly used for steering while rear wheels provide grip/ tractions.

Traction / grip

Is the pulling ability of a tractor influenced by the type of soil and its condition on which it is working.

Ways of improving traction/grip

- Ballasting the tyres.
  Is the addition of water /pumping of water into the tube of the tyre through a special valve that lets the water in and it allows air to escape
- By adding of weights in order to use stability of the tractor
- By reducing/increasing pressure in order to increase or reduce grip. However it should be excess.
- By using metallic wheels though not recommended on public rods, only useful in the field.
- By increasing the number of rear tyres; this increases stability
- Using chain on the wheels, metallic wheels are wound around the tyres and hence use traction
- By retreading tyres especially those which have worn out then tread bars to ensure stability on the ground especially in wet season to prevent sliding of tyres.
- By using the larger tyres to use the surface area available to grip the ground

Maintenance of lubrication system.

- Use the correct grade of oil in transmission system eg. In the gear box, differential, rear axle, etc
- Tyres must be inflated to the pressure recommended as under inflated plus over inflation damages tyres
- Check tyres regularly to avoid tyre explosion
- Carry out tyre retreading regularly or replace them

ELECTRICAL SYSTEM

Uses / function of Electrical system

- Provides power for operating the horn/hooting
- Produces a spark in petrol engines to ignite the fuel air mixture
- Provides power for lighting the head lights, the indicators, reap/ behind lamps
- Provides power to operate the wiper.
- Provides power for starting devices on the engine
- Generates power for recharging the battery
- Provide power for starting the engine.

Types of electrical system

a) Coil ignition system battery system
b) Magnental ignition system

a) The Coil ignition system

Here a low voltage current is produced by the chemical action within the battery (12v) This low voltage (12v) is stepped up by the ignition coil to a high voltage 10000v-4000v needed to produce a spark.

b) Magnental ignition system

Instead of a battery, low voltage current is produced by rotation of magnets. This voltage then flow to the primary winding of ignition coil and stepped up in the same way as in coil ignition system.

Component of the coil ignition system.

- Battery
- Ignition switch
- Induction/ignition coil
- Distribution
- Spark plug
- Starter mortar
- Generator /dynamo
- Contact breaker point

Diagram here.....

Functions of the components of coil ignition system

1. **Battery**
   Stores electricity in chemical form.
   Supplies electric current to the ignition
2. **Ignition switch**
   Completes the primary circuit when switched on so that current can flow from battery to induction coil
3. **Ignition /induction coil**
   Steps up low voltage current from battery to high voltage current
4. **Contact breaker point.**
   Interrupts the flow of current to the coil at desired time
5. **Starter mortar**
   Rotates the fly wheel so that the engine can start
6. **Dynamo**
   Produces/generates electricity for recharging the battery
7. **Distribution.**
   Distributes high voltage current to the spark plugs as required
8. **Spark plug**
   Has a gap between the terminals across which a spark jumps and ignites fuel air mixture
9. **Cut out**
   Disconnects battery from the dynamo so that it does not discharge to the generation when the engine is off/ running at a low speed.
10. **Alternator**
    Connects alternating current to direct current.

Operation mechanism of coil ignition system.

- When the ignition key is switched on, the battery produces a small voltage current of about 12v
- Low voltage current flows to the ignition coil

- Ignition coil steps up the low voltage current generated from the battery from 12v to 10000v
- High voltage current flows to the distributor
- Distributor distributes current to various spark plugs
- Sparks are created across the spark gap which jump out and burn fuel air mixture in the cylinder during the ignition stroke

Maintenance of Electrical system

- Keep all terminal and connections clear and tight
- Drive belt for the generator should be maintained at correct tension
- Contact breaker points should be serviced regularly
- Spark plug and distribution points should be kept clean
- Ensure that the spark plug gaps are kept at recommended value ie (0.6mm)
- Ensure that the battery is firmly fixed to prevent flashing of due to vibrations of the engine.
- Keep the battery on a piece of wood especially if it is not to be used for so long.
- Ensure that terminals are correctly connected to the tractor
- Check the specific gravity of electrolyte regularly using a hydro meter
- Check the level of electrolyte regularly ensure its at required level

  Draw the structures of the following

  i) Spark plug

  ii) Battery

  iii) Name and give functions of each part

TILLAGE IMPLEMENTS

Define tillage?

Tillage is the preparation of soil for keeping it loose and free from weeds during growth of crops.

It also refers to the mechanical breaking and stirring of soil carried out for purpose of caring and rising of crops.

Types of tillage

- **Primary Tillage**

  Refers to the breaking up of soil in the initial stages of land preparation for planting

- **Secondary Tillage**

  Refers to the subsequent operations that follow the initial opening up of land ie breaking up of clods and preparing the seed bed ready for operation.

Primary Tillage implements, These are implements which are used to open upland in the initial stages of preparation for planting. These implements are quite heavy and are used for deep ploughing.

They include;-

- Disc plough
- Mould Board plough
- Chisel ploughs
- Sub-soilers
- Ox-drawn mould Board plough

Objectives of primary Tillage

- To loosen the soil in order to make it suitable for crop growth
- To burry surface vegetation in order to kill weeds founds on top surfaces.
- To facilitate entry and free circulation of air in the soil
- To allow optimum aeration of a soil that allows good plant growth
- To encourage good water infiltration from the surfaces down into the sub soil
- To burry crop straws in order to destroy crop pests and diseases which may be hiding in such places
- To level the soil surface in order to make it ready for secondary Tillage practices
- To incorporate fertilizers/manures into the soil

a) Ox-drawn mould board plough
This is a mould board plough pulled by oxen. It is pulled by means of a chain attached to the yoke of the draught animals. This is so because it is light in weight, simple to set and does not need special skills to operate.
Structure of ox plough diagram

Functions of structural parts

- **Main beam.**
  Provides attachment for all other parts of the plough
  It increases penetrate action of the share due to its weight.
- **Handle grips.**
  Enable the operator to hold and steer the implement
- **Mould board**
  Inverts the furrow and covers the vegetation materials
- **Frog.**
  Provide attachment for the mould board, land side and share
- **Share**
  Cuts the furrow slice and thorns it to the mould board
- **Handle stays**
  Stabilizes the plough
- **Land side,**
  It presses against the furrow wall, separating the furrow slice from un ploughed land which helps to make the plough steady. Or stabilizes the plough during ploughing
- **Draw bar / draft rod**
  It is used for pulling the plough
  A Chain is fixed in the hitch/link at the end of the draft rod and connected to the yoke
- **Hake**
  Provides an attachment on the beam where the depth rod can be regulated.

- **Depth rod /clevis**
  Used to adjust the depth and width of ploughing.
- **Land wheel**
  Regulates the depth of ploughing and this reduces resistance while plough.

Advantages of using ox-drawn mould board plough

- It does not require special skills to operate
- It is relatively cheap and can easily be affordable by most farmers
- It completely turns the furrow slice hence burying the vegetation well thus provides manure.
- It produces relatively good clean seed bed than disc ploughs
- It can be used to weed plants in rows
- It can be used for many operations like harvesting of root crops e.g. Cassava, potatoes ground nuts.

Disadvantages of ox-plough use

- It is easily damaged by certain obstacles like big to stores, tree stumps etc
- It can not be used on land with very dry soils
- It can be expensive to maintain especially when buying and trying to replace shares
- Can easily create soil hard pans due to ploughing at the constant / same depth
- It can not be used to plough in areas with sticky soils.
- Oxen may fall sick at peak periods which affects or delays farm operations

Maintenance of Electrical system.

- Sharpen the shares incase they get blunt
- Oiling all movable parts like wheels and bearings to reduce friction
- Cleaning and removing soil from the surface of the shares, mould board after a days look
- Replace worn out share and soil contacting components
- Greasing all metallic parts after working season to prevent rusting
- Higher bolts and nuts before working to avoid getting lost in the field
- Before storing the plough at end of the season remove all soil that stick on the implement wash and use waste oil to coat the implement
- Store under a shed when ploughing is not in use.

Reason why ox-cultivation has succeeded in Northern Eastern Uganda.

- Integrated cattle and crop production, strong indigenous cattle with well developed humps are part of the farming system in these areas.
- Availability of plenty of land on which cattle are grazed and crop grown
- Presence of sandy light soils in these areas which makes ploughing easy.
- Presence of short and light vegetation which makes it easy to plough the land using animals power
- Presence of relatively flat land large enough for raising of animals
- Availability of extension and training centers where both farmers and animals can be trained.

- In these areas ox implements are made locally and therefore cheap to buy.
- The maintenance costs for both oxen and implements are lower than those required for the tractor and its implements

b) Disc ploughs.

This consists of a number of discs mounted on the beam by disc hangers. These ploughs are heavily built to enable them penetrate the ground by their own weight.

Structure of a disc plough. Diagram .....

<u>Functions of the structural parts</u>

- **Beam.**
  Supports the whole implement and provides attachment for all parts of the plough
- **Discs /disc blade**
  It cuts, turn and invert the furrows slice
- **Disc hanger/standard**
  Support the discs
  Provides room for the bearing which allows for setting the angles of the discs
- **Scrappers**
  Keeps the discs clean especially in wet conditions where the soil sticks on the discs
  Gives a push to the furrow slice for complete inversion
- **Furrow wheel.**
  It is used for setting the depth of the plough
- **Top link bracket**
  Used together with the cross shaft to mount the plough onto the tractor

<u>Advantages of disc ploughs</u>

- Rides over obstacles such as stones, tree stumps, without damage because of the rolling action of discs
- Can be used in dry/hard soil areas that are too difficult for MBP
- Works well in both light and heavy sticky soils
- Requires low maintenance costs because it has no shares to sharpen or replace frequently i.e. disc blade are long lasting
- It is generally quicker in operation and requires less power to pull it

<u>Disadvantages of disc plough</u>

- It does not cover trash properly and thus its soil inversion is very poor
- It leaves the field in a rough condition, hence need for subsequent operations ie secondary tillage is required.
- It is heavier than mould board plough
- It is expensive to buy the disc plough implement than ox plough

<u>Care and mentainance of disc ploughs</u>

- Clean the disc blades and coulter after ploughing
- Lubricate and grease the bearings after work as recommended by the manufacturers
- Repair and replace an broken parts of the plough

- Smear the discs, furrow wheel with old engine oil to prevent rusting i.e. if the plough is not to be used for a long time
- Tighten the bolts and nuts to avoid loosing them during operation
- Proper storage of the implement under shed to avoid rusting.

<u>The Disc Plough Bottom</u> –diagram here

Structural differences between ox-drawn MBP and Disc plough

Disc Ploughs	**Ox mould board ploughs**
▪ Has furrow wheel	▪ Has depth wheel
▪ Has disc blade for cutting furrow slice	▪ Has a share for cutting furrow slice
▪ Has a spring	▪ No spring
▪ Has scrapper	▪ Has no scrapper
▪ Has depth rod	▪ No depth rod
▪ Has top hall bracket	▪ Has hall
▪ Has cross shaft	▪ Has a hitch
▪ Has a standard /disc hanger	▪ Has no disc hanger
▪ Has no land side	▪ Has land side

Secondary Tillage implements; these are implements which stir the soil at comparatively shallow depth. It is possible to use some primary Tillage machines to carry out secondary Tillage operations **.**The secondary Tillage implements include;

-Harrows -Cultivators -Rotary cultivators -Rollers

<u>Objectives of secondary Tillage</u>

- To break soil clods in order to produce good or fine tilth
- To level the soil surface making it ready for planting
- To loosen and compact soil layers e.g. hard pans and soil caps
- To eradicate/ control pests completely
- To control weeds completely that could have already germinated after primary Tillage.
- To restore required soil structure and texture for popper crop growth.

<u>Assignment</u>

Figure below shows a farm implement used at the farm

a) With a reason, suggest whether the above implement is secondary or primary implement
   Name parts labeled
   i-v
b) Give the functions of each part i-v
c) Identify and name 4 examples of disc harrows

PLANTING EQUIPMENTS

Planting equipment is any power operated device/machine used to place seeds, plant parts on the soil for propagation, and production of food, fibre and feed crops. Features of planting equipments, planting equipment should have at least one of the features;

- A mechanism of regulating the seed rate
- A mechanism of varying the depth of planting
- A mechanism of varying the distance between the rows and plants within the rows

The row crop planters

These are planters designed and constructed to plant seeds in rows far enough to allow subsequent operations such as weeding, spraying, harvesting, pruning etc to be carried out.

Qualities of a good row crop planter

- Should be planting seeding of different sizes properly
- Should be handling a wide variety of seed rates
- Should plant seeds and cover them at uniform depth and entrails to encourage uniform growth
- Should be planting seeds in the same number of the quantity but not depending on the amount of seeds in the hopper

Structure of row crop planter diagram here……

Components include;

- Seed hopper
- Seed metering unit/device
- Furrow opener
- Delivery tube
- Press wheel
- Drive shaft

Functions of parts

- **Seed hopper**
  Stores seeds for planting
- **Fertilizer hopper**
  Stores solid fertilizer for applying during planting process
- **Seed metering device**
  This controls placing of seeds at a given rate
- **Furrow opener**
  Opens the soil/creates a furrow/hole for the seed /planting materials to be placed.
- **Delivery tube**
  Conveys the seed from the seed metering unit in the furrow.
- **Press wheel**
  Covers the seed that has been placed in the furrow/hole
- **Drive shaft**
  Driven by the drive chain. It makes the seed plate rotate inside.

Functions of the planter / how it work

When the planter is being pulled by the tractor or oxen;

1. It opens the furrow/hoe in the soil which is done by furrow opener
2. It is used in metering seeds; this helps to control the seed rate/ also selects the seeds from the hopper which delivers them into the soil through the deliver tube.
3. The planter's seed plate then drops one seed at time. As the planter is being pulled the press wheel drives the chain which in turn drives the sprocket and this drives the seed plate inside as it rotates, it then picks the seed which have been delivered through the delivery tube from the seed hopper.
   The seeds are dropped in the already made furrow.
4. Placing seeds by delivery tube where seeds pan and join the already made furrow.
5. It covers seeds, done by press wheel
6. Firming the seed which is done by press wheel. This function of planter prevents seeds from being eater by birds. It also ensures that seeds are in close contact with soil moisture and air.

Care and mentainance of planter

- check the seed metering unit to determine if the system is suited to the type of seed being used
- Ensure proper functioning of the press wheel
- Clean the furrow openers and covering devices
- Oiling / greasing the planter parts to prevent rusting
- Clean the seed hoppers and coat moving parts with heavy oil
- Clean seed delivery tubes after work
- Check the tension of the chain and adjust where necessary

FARM TOOLS AND EQUIPMENTS

a) GARDEN TOOLS

Hand hoe

Used for preparing garden, planting, weeding, harvesting crops

Forked hoe

Used to weeding / remove rhizomatous weed

Rake

Used for leveling the soil surfaces especially in the nursery beds, breaking big soil crumbs into small ones

Used for collecting weeds from seed bed /grasses

Used for covering vegetable seed after broadcasting

Gardener trowel

Uprooting seedlings/lifting seedlings from the nursery bed during transplanting

Folk (has prongs with handle like spade)

Weeding especially in the nursery beds

Softening of soils at transplanting time

Garden fork

Uprooting and weeding seedlings in a nursery bed

Dutch hoe/gardeners hoe
Used for weeding closely spaced crops e.g. vegetables and millet whose delicate stems and roots can easily be damaged if an ordinary hoe with a broad blade is used.
Manure fork
Used to trim manure in a composite pit
Used to load /load off manure on trailer/ car/tractor
Dibber wooden tool
Used to make holes in the ground for transplanting seedlings
Knapsack sprayer
For spraying to kill pest / weeds
Panga
Used for cutting small stems and branches
Used for land clearing
Used to harvest crops like sugarcane and bananas
Slasher
Used for cutting grasses and light vegetation
Sickle
Used for harvesting hay, rice
Axe
Used for cutting and felling trees
Secateurs
Used for pruning saw
Has a curved blade for pruning big branches and stems of tree crops
Planting line
Is a string which is used to establish a line along which a crop is to be planted
Watering can
Used for applying water to crops
Wheel barrow
Used for carrying loads, water, seedling

b) <u>WORK SHOP TOOLS</u>

- **Hand saw / cross cut saw**
  Used for cutting woods across grains
- **Rip saw**
  Used for cutting wood along the grains

- **Tin snip**
  Scissor used for cutting thin sheets of metal
- **Tenon saw / back saw/ precision saw(**short, big blade**)**
  Used for cutting of joints
- **Hack saw**
  Used for cutting rods of metal/steel
- **Coping saw**
  Used for cutting wood along curves

- **Compass saw** Used for making key holes in wood/curves and narrow surfaces like holes
  Used for cutting irregular lines in wood
- **Spoke shave**
  Used for cutting and shaping irregular work
  Used in forming curved edges on boards or used for planning curved surfaces
- **Jack plane (wooden jack plane/ metallic jack plane)**
  It shaves the surfaces of timber to make them plain, flat and smooth
- **Smoothing plane**
  Used to finish surfaces of timber after the jack plane has been used.
- **Wood chisel**
  Used for removing the sheets / layers of wood that may not be required when shaping surfaces
- **Cold chisel**
  Removing layers not required /shaping metals and stones
- **Claw hammer**
  Driving nails into/removing nails from wood.
- **Ball Pane Hammer**
  Used for shaping metals/riveting or making rivets or flattering sheet metals if folded.
- **Cross Pane Hammer**
  Benching/stretching thin metals e.g. – Nails to required shapes.
- **Pliers**
  Used for holding pieces of metals being worked on.
  Used also for cutting wires.
- **Mallet**
  Used for during chisels into wood when making desired cuts/hammering tools with wooden handler.
- **Marking gauge**
  Used to mark lines on timber which are parallel to any one true edge.
- **G-Clamp**
  Used to hold wood/timber to the bench during cutting/layout operators.
- **Spanners**
  (i) Ring Spanner
  Tightening/loosening nuts on bolts. NAME OTHER SPANNER TYPES ?
- **Brace**
  Used to bore holes in wood
- **Hand drill**
  Used for boring holes in wood/metals
- **Tape Measure**
  Take measurements of required length
- **Spirit level**
  Used for checking straightness of vertical and horizontal surface
- **Oil stone**
  Used for sharpening cutting tools
- **Screw driver**
  Drives screws in and out of metal or wood

- **Try Square/Square**
  Used for making accurate right angles measurements when planning & cutting timber
- **Files**
  Smoothing surfaces of wood & metals file for wood are rougher than those for metals

C) Livestock management tools

- **Milk can/bucket**
  For holding milk. Milk can for storing milk during transportation to market.
- **Strip cup**
  Detecting of mastitis
- **Milk Towels**
  Used for clearing cows udder during/before milking
- **Milking strainer**
  Used for filtering milk
- **Milk measuring cup**
  Measuring small quantities of milk e.g. – 1/2 , 1 litre when selling
- **Butter churn**
  Used for making butter from cream
- **Chaff cutter**
  For chopping fodder before being fed to cows
- **Drenching gum**
  Used for administering oral vaccines through the mouth
- **Rubber ring/elastrator**
  Elastrator used to stretch the rubber ring to be released on to the neck of scrotum during closed castration
- **Nose ring**
  Used to ease the handling of oxen during working
- **Burdizzol**
  Used for castration ie crushing spermatic cods of bulls
- **Trocar & Cannula**
  Used for treating bloat
- **Halter**
  Used for leading animals
- **Vet thermometer**
  For taking temperature of animals especially the skill ones
- **Syringe**
  Used for administering drugs/injections

FACTORS THAT DETERMINE THE CHOICE OF TOOLS AND EQUIPMENTS USED AT THE FARM

- **Topography**
  Areas with high/steep slopes do not allow use of tractors while flat areas tractors can be used.
- **Nature of work on the farm**
  As different activities require different tools and equipments e.g – when spraying equipments are only required.

- **Financial status of the farmer**
  Farmers with little capital prefer cheaper tools like hand tools while those with huge amount of capital use tractors.
- **Durability of equipments**
  The more the durability of the equipment the better the use/application by farmers
- **Type of soil**
  Sticky soils require disc plough as light soils require simple tools, mould board ploughs
- **Availability of spare parts**
  When the tools/equipments have spare parts, farmers should choose, farmers should avoid using equipments without spares near their farms.
- **Nature of vegetation**
  Areas with thick vegetation may require disc ploughs compared to those with light vegetation
- **Land tenure system**
  Fragmented pieces of land are difficult to mechanize and therefore require simple tools and equipments.
- **Conservativeness of farmers**
  Some farmers are not willing to adopt modern farming methods since they say that tractors destroy their soil structure.
- **Size of the farm / scale of production**
  Large scale farmers use large scale production tools such as tractors while small scale farmers use simple hand tools.

GENERAL CARE AND MENTANANCE PRATICLES OF FARM TOOLS AND EQUIPMENTS.

- Farm tools should be kept in a dry store and equipments like ploughs should be kept under shelter as direct sunshine is known to loosen handles of tools while rain causes iron parts to rust.
- Tools and equipments kept in store should be properly arranged to avoid breakage and injuries when taking them out.
- Tools should be cleaned immersed completely after use, and if to be kept for so long, metallic parts be coated with oil to prevent rusting
- Tools with sharp blades such as knives, axes and cut lasses should be sharpened regularly
- Bolts and nuts of farm machines should be inspected and tighten regularly to avoid getting lost and accidents
- Moving parts should be greased / oiled to reduce wear and tear also to increase efficiency
- Tyre pressure of wheeled equipments such as harrows should be checked regularly and adjusted accordingly
- Tools and equipments should be used for the purpose they were designed as this reduces chances of wear tear
- They should be serviced regularly following the manufacturers recommendations. Worn out puts should be replaced or repaired.
- Use of storage devices like carbonate, tool boxes, plastic guards etc for the care of sharp tools like saw, knives.