PAMPHLET FOR AGRICULTURE
FORM 4

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REFERENCES

This pamphlet/notes were compiled as referred from the following books:

1. Strides in Agriculture Student's Book 4 (B Kanjala et al); 2. Jhango Senior Agriculture book 4 (George Ludoviko); 3. Excel & Succeed Senior Secondary Agriculture Students Book 4 (Dr Wotchiwe Kalande); 4. Achievers Senior Secondary Agriculture Students Book 4 (Golden Chamanza); 5. Arise with Agriculture Students Book 4 (Dennis Kakolo et al); 6. East African Agriculture Third Edition (DN Ngugi et al); 7. Senior Secondary Agriculture (O. Akinsanmi); 8 Source Book on Financial Literacy in Agriculture (Malawi Institute of Education)

TOPIC 1: SOIL DEGRADATION

Soil degradation refers to the loss in the value and quality of soil making it unable to support plant growth.

1.1 FORMS OF SOIL DEGRADATION

i) **Physical degradation**

This occurs when soil structure is destroyed by rain or machines then the broken soil particles are eroded by wind or rainwater.

Physical degradation results in poor physical characteristics of soil. For example:

- Poor aeration / Poor drainage
- Reduced infiltration
- Reduced water holding capacity
- Poor capillarity

ii) **Chemical degradation**

This occurs when chemical properties of soil are changed hence reducing its productivity.

This form of degradation results in poor chemical characteristics of soil. For example:

- Very low soil pH (very high acidity).
- Reduced nutrient status of soil.
- Reduced ability of the soil to release cations. (low CEC)

1.2 CAUSES OF SOIL DEGRADATION

- Deforestation: due to high human population growth which creates great demand for forest products. This leaves land bare causing soil erosion hence the soil loses its value.
- Overgrazing: due to overstocking due to scarcity of land. This leaves land bare causing soil erosion and the soil loses its value.
- Bush fires: This destroys vegetative cover and organic matter in the soil making the soil vulnerable to erosion hence losing its value.
- Soil pollution: From Industrial waste such as heavy metals, plastics and excessive use of chemical fertiliser, pesticides and herbicides destroy chemical composition of soil leaving the soil less fertile.
- Bad farming practices: for example continuous cultivation, excessive use of heavy destroys soil structure, cultivation of steep slopes, along the slope, along river banks increases soil erosion, slash and burn cultivation destroys vegetative cover and organic matter causing soil erosion. Fire kills soil organism making the soil loses its value.
- Continuous cultivation: destroys soil structure making it prone to erosion, soil loses its value.

1.3 EFFECTS OF SOIL DEGRADATION ON CROP PRODUCTION

- Loss of fertile top soil resulting in reduced crop yields.
- Reduction of arable and grazing land due to formation of gullies and deposition of silt on the land. These prevent cultivation hence low crop production.
- Siltation of water reservoirs because they are filled up with eroded soil. This reduces their capacity to hold water and is difficult to pump water for irrigation so this reduces crop yields.
- Floods occur frequently since the capacity of water reservoirs to hold water is reduced this results in destruction of crops.
- Pollution of water sources as floods carry agrochemicals into water bodies resulting in poor quality irrigation water hence low crop yields.

- Spreading of water and soil borne diseases by eroded soil. These destroy crops hence in low crop yields.
- Spread of weed seeds as running water may carry and spread weed seeds to new areas resulting in reduced crop yields.

1.4 RELATIONSHIP BETWEEN RAPID POPULATION GROWTH AND SOIL DEGRADATION

The more rapid population growth becomes the more soil becomes degraded. This is because of the following reasons:

- The need for more animal products forces people keep more animals on small pieces of land (overstocking). This results into bare land exposing it to erosion hence the soil lose its value.
- The demand for forest products and land for settlement/ farming causes deforestation this leaves land bare causing soil erosion so the soil lose its value and quality.
- The need for more land for farming causes people cultivate marginal lands(steep slopes and river banks) this speed up soil erosion and the soil lose its value.
- The need to produce more food causes people to practice continuous cultivation. This destroys soil structure causing soil erosion leaving the soil with low nutrients.
- The need for more food products results into industrialisation. The wastes from these industries cause pollution of soil and irrigation water resulting in changes of chemical properties of soil.

1.5 METHODS OF CONTROLLING SOIL DEGRADATION

i) Biological or cultural control measures

These are farming practices that use vegetation to reduce soil erosion hence maintaining soil nutrients.

a) Planting trees and grasses: Trees and grasses reduce the speed of running water, the grass roots bind the soil particles preventing soil erosion. Trees act as a wind break to prevent wind erosion. Trees intercept raindrops hence reduce their impact on soil preventing soil erosion.
b) Planting close growing crops e.g. groundnuts, sweet potatoes, cucumber provide maximum soil cover to protect the soil against raindrop impact thus preventing splash erosion. They also reduce the speed of runoff and increase infiltration hence prevent soil erosion and maintain soil nutrients.
c) Practicing crop rotation: by alternating close growing crops with sparsely growing crops the close growing crops (cover crops) will offer protection on the soil.
d) Strip cropping: Growing different crops in strips along the contours and harvested at different times so that there is a strip of crops in the field at any given time to reduce the speed of runoff.
e) Mulching: *Provide a soil cover to prevent splash erosion.
*It reduces the speed of runoff and increase infiltration hence preventing soil erosion.
*Organic mulch decompose and provide nutrients to the soil.
f) Rotational grazing: To allow pasture to recover and form a soil cover hence preventing soil erosion.
g) Manure application:* Manure maintains soil structure hence preventing soil erosion.
*Manure add soil fertility/nutrients.
h) Planting grass strips: These reduce the speed of run off and trap soil.

ii) Physical measures

This are constructed structures which help to reduce the speed or run off and increasing infiltration hence controlling soil erosion. Examples are as follows:

a) Storm water drains: This diverts water from upland into a natural water way or artificial waterway.
b) Gabion check dam: It is built across slopes and gullies to slow down the speed of run-off.
c) Contour band: These are heaps of soil made across the slope following the contour to catch run off and increase infiltration
d) Cut-off drains/graded bands: These are channels that drain out water from the farm and divert it into natural or artificial waterway.

e) Terraces: It is an embankment or ridge of soil constructed across the slope in form of steps. They reduce the speed of run-off hence controls soil erosion.
f) Box (Tie) ridges: these act as a basin to catch and hold rainwater hence preventing soil erosion.

TOPIC 2: AGRICULTURE AND CLIMATE CHANGE

2.1 WAYS OF DEALING WITH CLIMATE CHANGE IN AGRICULTURE

2.1.1 Conservation Agriculture

It is a set of soil management practices or principles that reduces disruption of the soil structure and composition for sustainable production.

Three pillars/principles of conservation agriculture

- Minimum soil disturbance
- Diversified crop species or crop rotation
- Promotion of permanent soil cover.

i) Minimum soil disturbances

Soil disturbance occurs during land preparation, weeding and in case of root crops during harvesting.

Activities that promote minimum soil disturbances

- Use of herbicides for weeding;
- Making of permanent planting pits;
- Terracing;
- Making of permanent planting ridges made on a contour with tie ridges in between;

How can minimum soil disturbance deal with climate change?

- Maintains soil structure so the soil holds enough moisture for crops to use during dry spells.
- Reduces soil erosion/maintain soil nutrients so that plants can grow fast and escape dry spells.
- Reduces carbon dioxide emissions into the air and accumulation of more carbon in the soil thus reducing greenhouse effect and global warming.

ii) Diversified crop species or crop rotation

Activities done:

- Growing different types of crops on the same piece of land following a definite order.
- Growing two or more crops on the same land.

How can diversified crop species or crop rotation deal with climate change?

- Replaces the lost nutrients when legumes fix nitrogen. This speeds up crop growth and maturity so that they can escape time of insufficient rainfall or dry spells.
- Controls host specific pests by breaking their life cycle.
- There is a wide variety of crops. If one fails a farmer can depend on the other.
- Controls soil erosion if cover crops are included in rotation they break the force of raindrops.
- Reduces weed infestation since many crops form a canopy which suppress weed growth.

iii) Promotion of permanent soil cover:

Activities done:

- Covering the soil with dead plants, green manure, crop residues.
- Fallow period.
- Growing cover crops for example sweet potatoes, groundnuts, cucumber.

How can permanent soil cover deal with climate change?

- Protects the soil from raindrop impact thus preventing soil erosion.

- Provides humus after decomposition to improve soil structure. This helps in conservation of moisture by increasing infiltration to sustain crop growth during the dry spells.
- Reduces evaporation hence maintains soil moisture.
- The organic matter increases percolation of water to allow it move from the deeper soil layers to the plant root zone to sustain plant growth during drought.
- Improve soil fertility after decomposition this promote plant growth and maturity so that they are able to escape dry spells.
- Prevents multiplication of weeds by smothering them.
- Reduces evaporation hence conserves moisture to be used in the dry spells.
- Mulches help to prevent overheating of the soil hence modifying soil temperature.

2.1.2 Rain Water Harvesting

It is the process of collecting and storing rain water from direct rain fall or runoff for re use.

Activities involved in rainwater harvesting

- Collecting water from a roof or runoff from a catchment area such as a foot path, road drains, rock catchment or a flooding river.
- Moving the water to a storage structure.
- Storing the water into a water harvesting structure.

Rain water harvesting technologies /structures

Farm ponds, Tanks, Grass strips, Rock catchment, Dams, Planting pits, Manure application, Box ridges, Infiltration pits or retention ditches, Terraces, river diversions, roof tops,

How can rain water harvesting technologies mitigate climate change?

- It increases soil moisture and hence supplement direct rainfall.
- Helps to prevent flooding as water is captured before it runs down to the rivers.
- It is used for irrigation and domestic purpose during drought.
- It is used for recharging ground water sources through increased infiltration.
- It is used to supplement the main supply when demand is high than supply.

2.1.3 Agroforestry

Agroforestry refers to land use systems and practices in which trees or shrubs are grown around or among crops or pasture land.

Activities done in Agroforestry

Planting trees, shrubs such as Tephrosia Vogelii, Leucaena, Nsangu etc by alternating them with crop strips.

Planting fruit trees such as avocado pears, mangoes and trees for wood and timber by scattering them over a large plot of crops or pasture.

How can agroforestry deal with climate change?

- Reduces soil erosion since tree reduces speed of runoff and the roots bind soil particles.
- Improves soil fertility since leguminous trees fix nitrogen. This speeds up crop growth so that they can escape dry spells. Trees bring up lost nutrients from sub-soil since they have deep roots.
- Provides medicinal products from leaves and fruits.
- Provide shade and protect crops, livestock and humans from excess temperature.
- Source of fuel, building materials to prevent deforestation.
- Trees used as feed for livestock.

2.1.4 Re-afforestation

It is the reestablishment of forests in an area that had trees which were cut down.

Activities done in re- afforestation

a) Establishing and managing tree nursery b) Planting and managing trees on the site (out planting)

How can re-afforestation deal with climate change?

- Trees reduces amount of carbon dioxide in the atmosphere by using it during photosynthesis.
- Trees bring about rainfall by releasing water back into the atmosphere.
- It helps to maintain soil moisture by increasing infiltration.
- Trees help in conservation of water and soil by breaking the force of rain drops and reducing the speed of run off.

2.1.5 Integrated forest, farm and fish systems

This is a farming system in which a tree are grown together with crops or where livestock may be kept in a forest or may be kept near or above fish ponds

How can integrated forest farm and fish systems deal with climate change?

- Trees absorb carbon dioxide from atmosphere hence reducing global warming.
- Animal wastes are used for production of bio gas which is used for cooking to avoid deforestation.
- Manure from livestock are used to improve soil fertility for high crop production.
- Crop remains and tree branches are used as feed for animals.
- Animal wastes are safely disposed in fish pond to avoid production of methane gas one of the greenhouse gases(GHGs)
- Chicken manure is used to promote growth of planktons. This help to reduce amount of chemical fertilisers applied to fish ponds there by reducing emission of nitrous oxide greenhouse gas.
- Water that is drained from fish pond is used for irrigating crops.

TOPIC 3: LAND DRAINAGE

Land drainage is the practice of removing excess water from the land. The collected water is conducted to a natural water way e.g. a stream, river, and lake or to a storage tank.

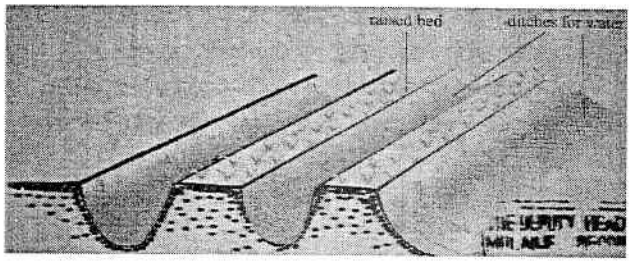
3.1 Importance of land drainage

- It facilitates soil aeration since the pores previously occupied by the water will hold air.
- It improves workability of soil since soil with excessive water sticks to implements.
- Used to reclaim swampy/ waterlogged areas hence increases amount of land available for farming.
- It helps to prevent flooding if the excess water is redirected to a storage tank.
- It reduces spread of water borne diseases e.g. malaria by destroying their breeding grounds.
- It raises soil temperature as there is reduced cooling effect by removed water.
- Reduces accumulation of salts by flashing removing them together with water.

3.2 Methods of land drainage

3.2.1 Surface drainage: This is the removal of excess water from the surface of land

i) Open ditches (U or V shaped open ditches)



They must be deep and wide enough to be effective (1-2m deep and 1-2m wide)
They can be spaced from 50-200m apart depending on the permeability of the soil
Water from the surrounding ditch flows into the ditch.
Drainage ditches are also constructed on the sides of roads used to drain water safely from road

ii) Cambered bed
This is done by making large heaps of soil in form of big and broad ridges or mounds on which crops are grown. The water collects and drains into the space between the ridges. Water flows away through the spaces between the ridges by gravity.
- They are convex in shape.

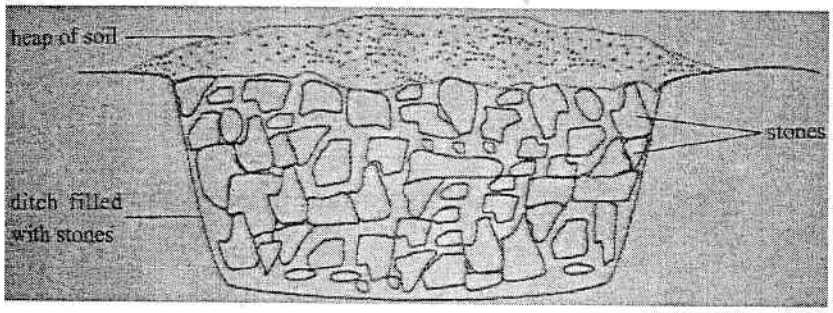
iii) Pumping: It involves the use of pumps to remove water and conduct it away to a natural water way or to a storage tank.

Advantages of surface drainage
a) Can drained large quantities of water b) Cheap and easy to construct (c) Require less skills
(d) Easy way of reclaiming swampy area,

Disadvantages of surface drainage
a) It interferes with mechanisations of operations; b) They harbour rodents which may destroy crops;
c) Soil erosion may arise if the ditches are not well designed; d). It requires constant removing of silt
e) It takes off land space which could have been used for planting of crops;

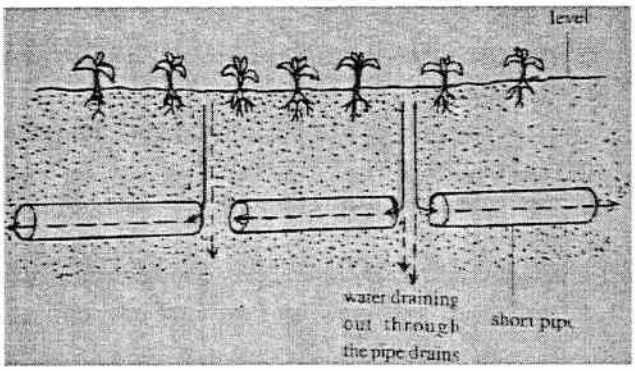
3.2.2 Subsurface Drainage: This is the removal of excess water below the land surface.
The system uses porous pipes or tunnels which are laid below the soil surface. Small stones are laid over the pipes and the drain. The water collected is led away to the desired location.

Subsurface drainage methods
i) Mole drains
These are made by a tractor pulling a cylindrical plug under the ground.
ii) French drains: These are also called stone drains



These are ditches dug to a depth of 60cm and filled with stones. The stones are covered with trash and light soil. Water slowly drains from the surrounding area into the drain. French drains are constructed along the contours.

iii) Porous or perforated pipes



Short pieces of pipe about 30-40m are laid underground and run from end to end
There are gaps between the pipes to allow water to drain into them and be conducted away.
The pipes are either made of clay, concrete, plastic or steel.
Perforated pipes are also used such that water sips through the perforations and is conducted away.

Advantages of subsurface drainage

a) Does not reduce agricultural land; b) Does not interfere with movement of machines
c) Does not interfere with field operations

Disadvantages of subsurface drainage

a) High maintenance costs due to constant blockages; b) Blockage of tunnels as at steep areas can occur due to soil erosion; c). Pipes are expensive; d). It require skill

3.2.3 Bio drainage

Involves planting of fast growing, deep rooted trees in waterlogged areas e.g. blue gum trees and pine trees.

How can the trees help to remove excess water from the land?

- Their roots penetrates deep in the soil creating waterways for water to seep through.
- The trees also take up a lot of water which is then lost through transpiration.

Advantages of Bio drainage

- Trees help to mitigate the effects of climate change by taking part in the rainfall cycle.
- Trees purify air by absorbing carbon dioxide preventing global warming.
- Trees act as a wind break.
- Moderate the temperature of the surrounding through transpiration.
- As trees grow they increase their value instead of depreciating.
- Cheap to maintain.
- The method combines both drainage and disposal hence no need to look for a drainage disposal.

TOPIC 4: FARM MECHANISATION

Farm mechanisation refers to the use of power driven machinery and implements to carry out farming operations.

Types of farm machinery

Tractor-drawn implements; Animal-drawn implements; Machines operated by human power

4.1.2 Tractor drawn implements

These are instruments attached to a tractor to carry out various operations. These are very heavy so they cannot be drawn easily using human or animal power. Mechanical power is required to pull them
Examples include cultivators, harrows, trailers, mowers, planters and seeders, weeders, sprayers and harvesting machines.

a) **CULTIVATORS**

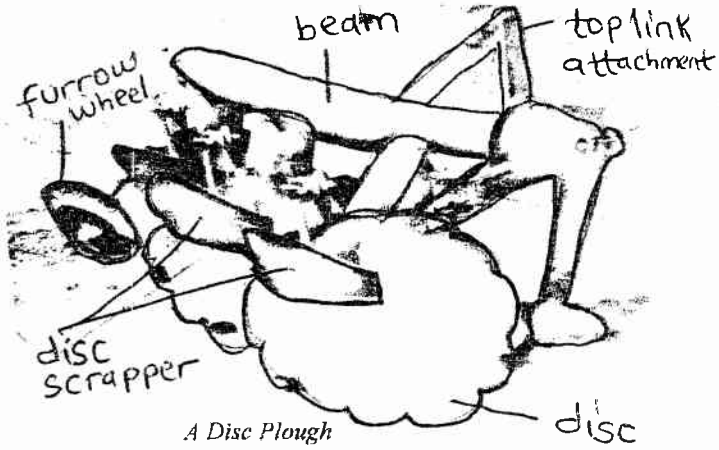
a) **CULTIVATORS**

These are primary tillage machines used for breaking up the soil e.g. Ploughs, Tillers and Sub- soiler

i) Ploughs

Examples: Disc plough, mouldboard plough and chisel plough

Used for ploughing



A Disc Plough

Disc plough

It has 3-6 discs which are mounted on a standard hangers fixed on the beam

When ploughing, the discs roll cutting furrow slices and throwing them sideways

The disc plough is ideal in the field where there are obstacles such as rocks, stumps, since it is able to roll over these objects

Parts of a disc plough

The beam: This provides attachment for all other parts of the plough and adds more weight for better plough depth penetration.

The discs: They are concave in shape. They cut and push the furrow slices sideways

Scrappers: It is used to remove trash and mud or soil which may cling on to the discs and interfere with penetration.

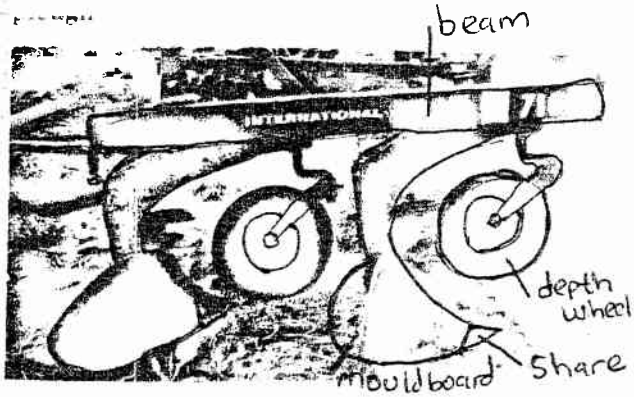
Depth wheel: a) It controls the depth of ploughing b) Helps in balancing the whole implement

Standard hangers: These connect the discs to the main beam. They allow the discs to rotate.

Maintenance

a) Tighten loose bolts and nuts b) Lubricate moving parts c) Replace worn out parts d) Sharpen discs

Mouldboard Plough



A Tractor-drawn Mouldboard Plough

Three to six mouldboards are mounted to the same beam

Mouldboard plough is used in soft soils, without obstacles since the plough can easily break

When ploughing it cuts the soil and turns the slice upside down burying surface trash completely

Parts of a mouldboard plough

Share: It makes horizontal cut in the soil

Mouldboard: Inverts furrow slices

Landslide: Stabilises the plough

Frog: connects the share, mouldboard and landslide to the frame

Beam: This is a metallic frame on which all other parts are attached

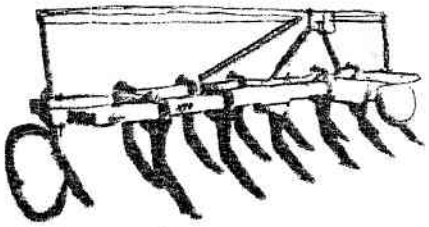
Skim coulter: Removes trash from between the furrow slices

Maintenance: a) Tighten loose bolts and nuts b) Lubricate moving parts
c) Replace worn out parts d) Sharpen the share

Chisel Plough

It has narrow and double ended shovels that are mounted on a beam

Use: Deep tillage to break soil with hard pans (hard and dry) with minimal soil disturbance



Chisel Plough

Maintenance
Tighten loose bolts and nuts
Straighten bent blades
Replace worn out parts
Clean after use

Tillers
An example of a tiller is rotary tiller. It is a multi- purpose equipment used for both primary and secondary cultivation.

It has high speed revolving blades.

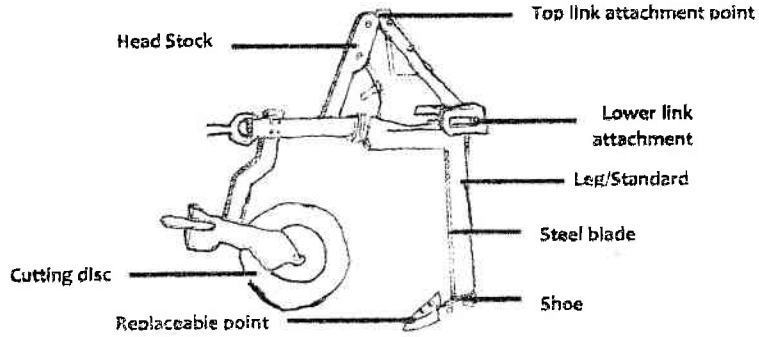
Use: a) Achieves two operation in one pass that; is cuts the furrow slices and breaks them.
b) Mixes trash and the soil.

Maintenance: a) Grease the moving parts; b) straighten bent blades; c) Replace worn out parts; d) Ensure that the bolts and nuts are always tight; e) Straighten bent blades; f) Clean after use; g) Lubricate the moving parts; h) Sharpen the blades if blunt;

Sub-Soiler: This is the strongest and heaviest implement

Use: To cultivate compacted soil. Used to break up the hardpan within the subsoil

Maintenance
- Tighten loose bolts and nuts
- Replace worn out parts
- Clean after use



Parts of a subsoiler

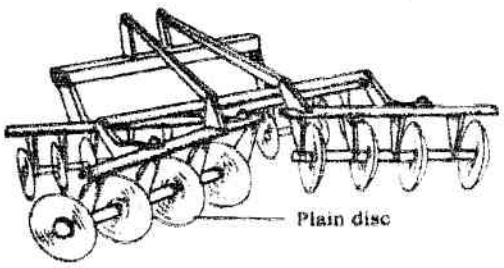
b) **HARROWS**

These are implements used for secondary tillage. The main use of harrows is for breaking up large clods of soil after ploughing. Breaking up large clods of soil is called harrowing

Other uses of harrows: Destroying weeds; Covering broadcast seeds; Incorporating manure; Levelling of seedbeds;

Types of harrows

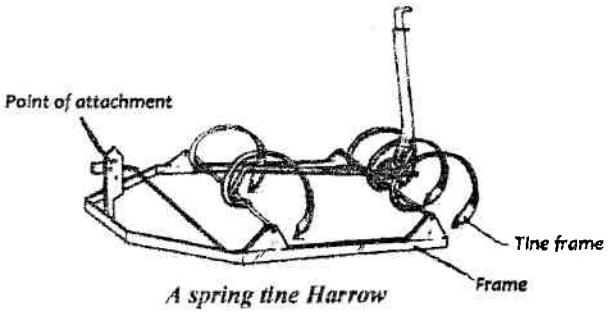
i) Disc harrow



Four-gang harrow in a tandem.

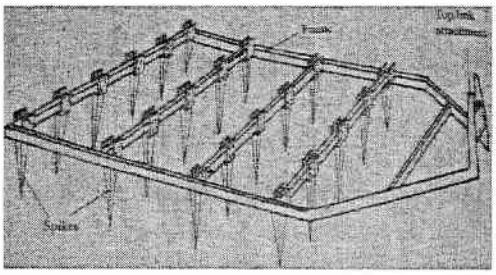
4-8 smaller discs are mounted on one shaft forming a gang. Two to four gangs are mounted on the beam. A gang rotates as a unit. The discs push the soil in the opposite direction when harrowing.

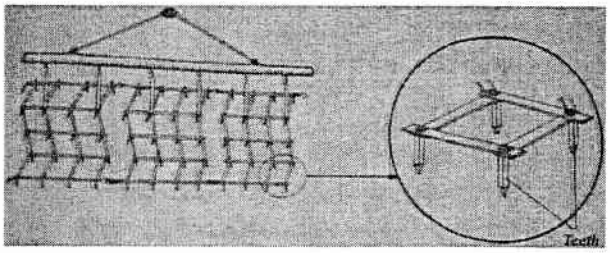
ii) spring tine harrow



A spring tine Harrow

It has a coiled spring tines fixed on a frame. When harrowing the tines vibrates and these vibrations helps to break up the soil clods





iii. Spike tooth harrow
It has several strong pointed spikes mounted on a frame

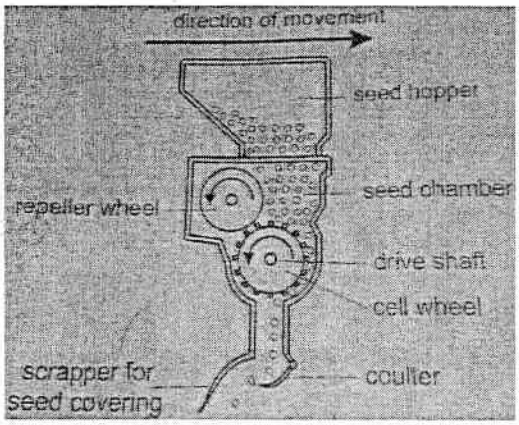
iv. Zig zag harrows
It has tines which are arranged on the frame in a zigzag manner.

Maintenance
a) Tighten loose bolts and nuts b) Replace worn out parts e.g. discs, tines c) Clean after use
d) Lubricate the moving parts e) Sharpen the discs, spikes if blunt

c) **TRAILER :** This is a container which is pulled by a tractor
Use: To carry various farm produce and inputs to and from the farm.

Maintenance
a) Check tyre pressure and adjust it accordingly b) Lubricate the wheel bearings regularly
c) Repair damaged parts.

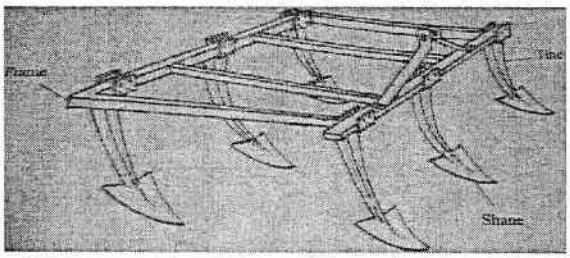
d) **PLANTERS AND SEEDERS**



Use: For planting. They open up the furrow, place the seed in the furrow and cover them.
They also apply fertilizer alongside planting

Maintenance
- Lubricate moving parts
- Remove any seed stuck in the seed slots
- Remove all seeds from the seed hopper after sowing

e) **CULTIVATORS / WEEDERS**



These are implements used in tilling the soil after emergence of crops. Use: To remove weeds in the field
Maintenance
- Tighten loose bolts and nuts
- Straighten bent blades
- Repair or replace worn out parts
- Clean after use
- Lubricate the moving parts
- Sharpen the cultivator points if blunt

f) **MOWERS**
Use: For cutting grass
Maintenance
a) Tighten loose bolts and nuts; b) Straighten bent blades; c) Repair or replace worn out parts
d) Clean after use; e) Lubricate the moving parts; f) Sharpen the blades if blunt

g) **HARVESTING MACHINES**

i). Combine harvester

It has four functions (cutting the crop, threshing of grains, cleaning or winnowing, packing the grains)

ii). Maize shellers

These are stationary machines used to remove grains from maize cobs.

They consist of discs which scrape the grains from the cobs. It may be fitted with a screen for separating the grains from husks and cobs and fans for cleaning the grains

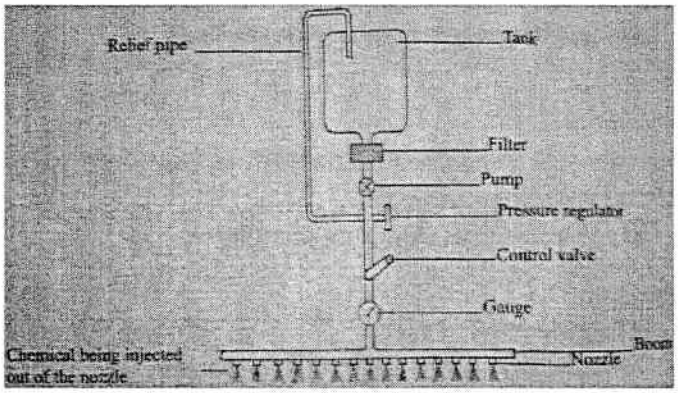
iii). Potato lifters: These are used in harvesting root crops e.g. irish potatoes. They lift tubers from the soil and collecting them.

iv). Forage harvester: Used in harvesting forage crops. It cuts the forage, Chop them into small pieces and directs the pieces into a trailer.

Maintenance of harvesting machines

a) Lubricate moving parts; b) Repair or replace worn out parts; c) Sharpen the cutting edges;
d) Remove foreign materials which have stuck in the machines at the end of the day's work; e) Tighten bolts and nuts;

h) **SPRAYERS**



These are used to spray chemicals in crop fields

Maintenance

- Empty the tank and wash the sprayer thoroughly.
- Repair or replace worn out parts such as filters and nozzles
- Lubricate the moving parts

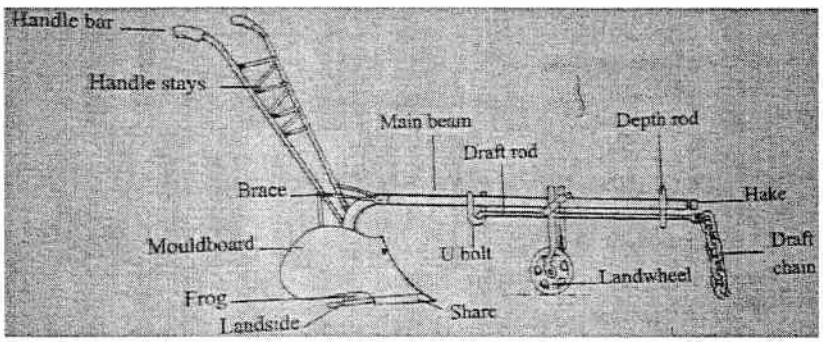
4.1.3 TRACTOR

USE: Provide energy for pulling farm machinery

Maintenance: Tyres should be properly inflated to correct pressure; Repair or replace worn out parts

4.1.4 ANIMAL DRAWN IMPLEMENTS

i) OX – PLOUGH



This is a mouldboard plough and is drawn by draught animals such as oxen and donkeys.
It has one mouldboard.
Main use: For ploughing
Other uses: weeding, opening furrow for planting

Parts of an ox drawn plough

Share: It cuts the furrow slice;

Mouldboard: Inverts the cut soil (slice);

Handles: Allows the operator to steer the implement in the proper direction during ploughing;

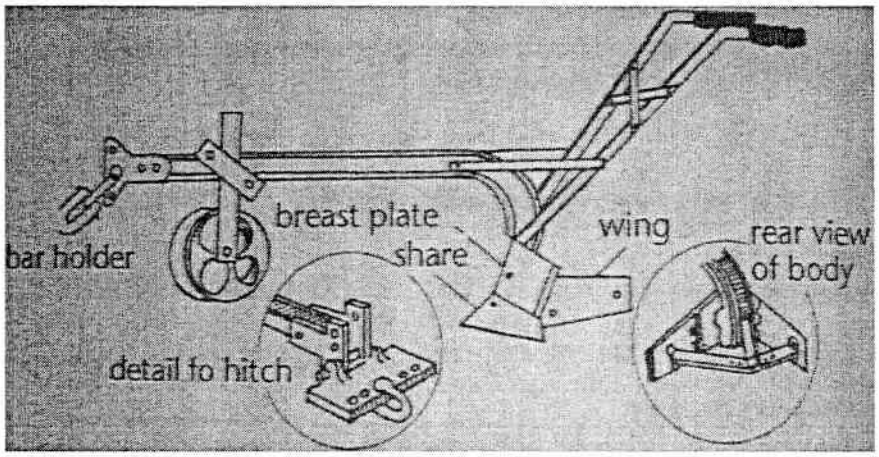
Beam: Provide attachment to all other parts of the plough;

Add weight to the plough for better penetration into the soil;

Draft rod: It is fitted with a chain that connects the plough to the york chain;
Hake: It is used holding parts of the plough which have been adjusted in position;
Depth rod: Used for adjusting the width and depth of ploughing;
Frog: Provides attachment for the mouldboard, share and land side;
Depth wheel: Regulates the depth of ploughing
Landside: Stabilizes the plough

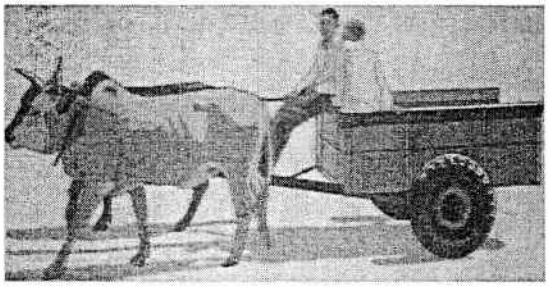
Maintenance
a) Tighten loose bolts and nuts; b) Repair or replace worn out parts; c) Clean after use; d) Lubricate the moving parts; e) Sharpen the share; f) Paint the handles and the beam to prevent rusting;

ii) **OX RIDGER**
This is an implement used to make ridges. It has two wings fixed opposite each other on the beam. When pulled, the wings make two soil heaps and a single furrow. A return pass completes the ridge



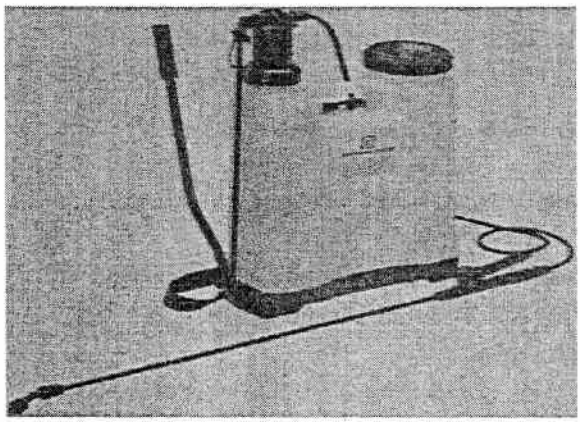
Maintenance
- Tighten bolts and nuts;
- Repair or replace worn out parts;
- Clean after use;
- Lubricate the moving parts
- Sharpen the share;
- Paint the handles and the beam to prevent rusting;

iii) **OX CARTS**
It has a container and two rear wheels. It is pulled by two animals.



Use
To transport farm produce and inputs from the farm to the ware house and from the ware house to the farm respectively.
Maintenance
- Tighten loose bolts and nuts
- Repair or replace worn out parts
- Lubricate the moving parts
- Check the tyre pressure and adjust accordingly

Machines operated by human power
i) A garden sprayer/ Knapsack sprayer



Use: For spraying chemicals to the field
Maintenance
Empty the tank and wash the sprayer thoroughly;
Repair or replace worn out parts such as filters and nozzles;

ii) Milking machine
Use: To extract milk from the udder
Maintenance
Clean the machine and vacuum regulator always;
Replace the broken parts;

Safety measures when using Farm machinery

i) Safety measures when using tractor drawn (ploughs, ridgers, harrows, rotary tillers, trailers, mowers harvesters, weeders, planters)

- Switch off the engine when fuelling the machine;
- Ensure that the brakes, steering and battery of the tractor are in good condition;
- Do not use the machine when you are tired;
- Keep children away from working machines;
- Do not touch the engine when it is hot and running;
- Do not smoke or eat when working with machines since petrol is highly flammable;
- Ensure that all cutting blades are sharp and in good working condition;
- Do not use the tractor when the soil is too wet;
- Check the tyre pressure and adjust it properly;
- Ensure that there is no naked flame nearby when charging the battery;
- Ensure that there is enough water in the radiator and that the cooling system does not leak;
- Service the machine regularly i.e. by changing oil and the filters;
- Repair broken parts;
- Do not over load (a trailer);
- Do not wear loose clothing such as neckties when working with machines;

ii) Safety measures when using sprayers

- Do not smoke or eat when spraying crops;
- Avoid spraying against wind;
- Store chemicals away from children;
- Dispose of empty chemical containers properly;
- Wear protective clothing such as masks, gloves, boots and overalls during spraying;
- Wash your body thoroughly with soap and change clothes after spraying;
- Wash the sprayer thoroughly to ensure no chemical remains in the tank to avoid poisoning;

iii) Safety measures when Animal drawn implements (Ox cart, Ox plough and ridger)

- Do not overload an oxcart to prevent it from overturning.
- Make sure all parts are in good working condition.
- Ensure that the yoke is properly connected to the animals.
- Do not use the machine when animals are tired or not in good health.

Advantages of farm mechanisation

- Farm operations are done faster and completed in time resulting into increased production.
- Work is done easily with less sweat making it enjoyable.
- Mechanisation releases farmer's time for other development activities other than farming.
- Mechanisation improves production efficiency by reducing cost per unit of product.
- Allows farm expansion hence farmers benefit from economies of large scale production.
- Farm operations are done more efficiently with accuracy e.g. plant spacing.
- Work output is high since machines can work longer hours.

Limitations of farm mechanisation

- Use of machines on farms may take over the jobs of many people which results in increased cases of unemployment.
- Most farmers do not have capital to buy and maintain machines since they are expensive.
- Some crops may not be easily mechanized and this limits the choice of enterprise
- Requires skilled personnel to operate and maintain the machine
- Requires large farm holdings to generate enough money to cover cost running machines

- Require a flat land for easy movement of machines
- Fuel to run the machines and spare parts may not be available and the cost may be too high

Factors to consider when mechanising a farm

Size of farm holding: Mechanisation is possible on large land for easy movement of machine and a large land can generate enough capital to cover cost of running the machines.
Technical know-how: There should be skilled labour to operate, maintain and repair the machine.
Value of the crop: The value of the crop to be grown should be high in order to cover costs of mechanisation.
Topography of land: A flat land is suitable for easy movement of machines.
Availability of capital: It requires sufficient capital to buy machines, spare parts and fuel.
Availability of spare parts, fuel and oils. Should be readily available for smooth running of machines
Accessibility of the land: The land should be accessible to the machine.
Infrastructure: There should be adequate infrastructure e.g. good roads, bridges, rural electrification and well-structured market channels and water system to take care of increased production.
Employment opportunities: Unskilled farm labourers will lose their jobs because machines can do work that was done by humans.

TOPIC 5: FARM POWER

Farm power is the capacity of work that can be done per unit time. Power is necessary to enable different farm operations to be performed. It is measured in units of a joule per second. (Watts)

5.1 SOURCES OF FARM POWER

i) Human ii) Animal iii) Mechanical
iv) Wind v) Water vi) Solar vii) Biogas

5.1.1 Human Power

The energy is obtained from the carbohydrate food during respiration and is stored as chemical energy in the muscles. The chemical energy is converted into heat energy which later becomes mechanical energy. Human power is used to operate hand tools such as machetes, axes, slashers, hoes.

Uses of human power

1) Cultivation; 2) Watering; 3) spraying; 4) Harvesting;
5) Carrying out domestic, industrial work, construction; 6) Processing farm produce etc.

Advantages of human power

- It is an intelligent source of power since he is able to organize and control the work.
- It is cheap and readily available.
- It is a clean source of power (non-polluting).

Limitations of human power

- Work output is low since man can get tired.
- Very difficult to do heavy work like cultivating very hard soil, transporting farm produce.
- Slow hence takes a lot of time to complete a task.
- It is unreliable since it depends on the health status of the worker or other social factors.
- Can be moody hence not work efficiently.

Ways of improving work output from human power

- Improve health of people to ensure that they are always strong enough for the work.
- Train the workforce to improve their skills.
- Proper feeding since food is a source of energy in carrying farm operations.
- Motivate the workers with good working conditions so that they can be willing to work hard.

- Assign duties according to expertise.
- Provide efficient supervision to ensure quality work.
- Ensuring that rules and regulations are clearly understood by all workers.
- Promoting team work and cooperation to minimise conflicts as this delays work.
- Provide them with efficient tools.

5.1.2 Animal Power

It involves use of work animals like oxen, donkeys and camels when carrying out farm operations.

Uses of animal power

i) Pulling carts when transporting farm produce and inputs 2) Pulling implements during cultivation

Advantages

- Can work faster than human power;
- Can do heavier work than human power;
- Work output is higher than human power;
- It can be used where land is not accessible by tractors or where land is of irregular shape;
- It is relatively cheap to buy and maintain compared to mechanical power;
- It does not require specialised skill as in case with mechanical power;

Limitations

- Can get tired so work output is limited;
- Cannot handle large volume of work;
- Animals are likely to fall sick and may take long to recover hence not reliable;
- Animals require adequate feeding to work so there is a shortage of feeds in the dry season;

Ways of improving work output from animal power

- Harness animals properly so that they can be comfortable and work long hours.
- Animals should be properly trained to work long hours and effectively.
- Improve health of the animals to ensure they are always strong enough for the work.
- The working environment must be suitable i.e. without obstacles/tsetse flies to avoid injuries/irritation.
- Treat and handle animals properly do not overload or cause injuries.
- Use animals of equal sizes to avoid in balances on workload distribution.
- Proper feeding since food is a source of energy in carrying farm operations.
- Modernise farm equipment.

5.1.3 Mechanical Power

This is power transmitted through an engine which comes from the burning of fuels

Uses: Drives machines for cultivation, harvesting, spraying and for transporting farm produce.

Advantages

- It is used to operate a wider range of implements.
- Work output is very high. e.g. can cultivate more land per unit time than any other source of power hence allows farm expansion for economies of scale.
- It is very efficient and effective.
- Reduces drudgery of farm work.

Limitations

- Require skill to operate it and maintain.
- Expensive to buy machines, spare parts and fuel.
- It leads to environmental pollution.
- It leads to unemployment of people especially those who are unskilled.

Ways of improving work output from mechanical power

- Regular servicing and maintenance
- It should be replaced when its life span has expired
- Educate and train machine operators on how to handle and use the machine effective
- Use each machine according to the purpose or function that it is meant to perform

5.1.4 WATER POWER/ HYDRO ELECTRIC POWER

This is energy generated from flowing water which rotates turbines of a generator.

Uses of water power

- Production of electricity for cooking, heating.
- Drives water mills for which are use or grinding of cereal.
- Transport in navigable rivers.
- Operate a hydro pump to draw water for domestic purposes.

Advantages of water power

- It is environmental friendly since it does not cause pollution
- It is in exhaustible
- It can be used in a variety of farm operations

Limitations of water power

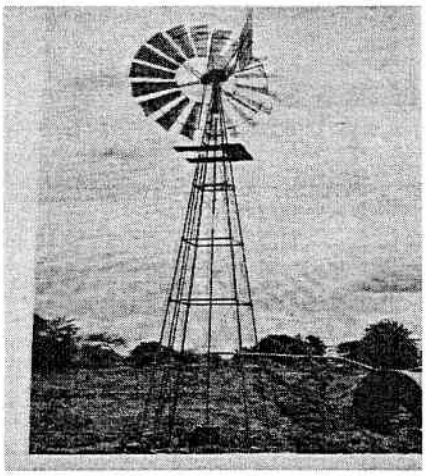
- It is expensive to generate hydroelectric power and to maintain machines used for generation
- Energy generation is affected by fluctuation of water levels in the river

Ways of improving work output from water power

- The source of water must be properly looked after through preventing siltation.
- Replace old turbans with new and efficient ones.
- Construct a dam to raise water level.
- Create a hydraulic head behind the dam so that water is released to the turbines with great force.

5.1.5 Wind Power

Wind is moving air. When air moves, its weight multiplied by velocity gives its power. Wind energy can be obtained by use of wind mills. Wind turbines should be placed vertically and close together



Uses:

- Used to rotate generators for production of electricity for cooking and lighting
- Used for winnowing crops such as beans, rice, millet after threshing.
- For pumping water from boreholes

Advantages

- It is in exhaustible (renewable)
- It is a non-pollutant
- It has a low maintenance cost

ill to

Limitations

- It is unreliable since it depends on speed of wind which may be too low to drive the wind mill
- Its direction cannot be controlled
- High initial cost of setting up the wind mill

5.1.6 SOLAR POWER

It is heat and light energy obtained from the sun. The energy is trapped from the sun's rays using solar panels and stored in solar batteries.

Uses of solar power:

i) For photosynthesis ii) Drying farm produce iii) Production of electricity used for cooking, lighting

Advantages

i) It is inexhaustible (renewable); ii) Non pollutant; iii) Readily available;

Disadvantage

i) Requires skills to install; ii) Expensive to install

iii) It is unreliable during cloudy days due to low intensity of sunlight; iv) Cannot be used directly

Ways of improving work output from solar power

- Use solar panels and batteries that suit their energy requirements.
- Install solar panels of high energy generation.
- Install many solar panels and batteries.
- Use batteries of high energy storage capacity.
- Solar panels should be placed in open areas with no shade in order to receive more energy.
- Avoid accumulation of dust on the panels.

5.1.7 BIOGAS POWER

This is a flammable gas produced when organic matter is decomposed by microorganisms in a biogas digester. The main raw material used is animal waste, others are crop residues, plant leaves, garbage. These decompose in the absence of oxygen producing Methane gas, residues is used as manure.

Uses of biogas power: Lighting; Cooking

Advantages of Bio gas power

- It is environmental friendly i.e. does not pollute air.
- It is cheap to generate once the digester is installed.
- The by-products of fermentation is an excellent source of manure.
- It has low maintenance costs.

Limitations of Bio gas power

- It is labour intensive since it requires large quantity of raw materials
- High installation cost
- Requires skills to install
- It is limited to few operations
- It is most appropriate where animals are reared under zero grazing
- Methane gas produced can cause global warming because is a greenhouse gas

Ways of improving output from biogas power

- Refill the digester regularly so that there is always enough dung for more gas production
- Use of a well maintained digester

TOPIC 6: GENDER AND AGRICULTURAL TECHNOLOGY

Gender bias refers to favouritism of a person due to sex which results in discrimination against males or females.

Examples of gender biases in agricultural technology

- When cultivating men use tractor drawn or animal drawn implements while women use a hand hoe on the same farm.
- More men conduct technologies like artificial insemination, vaccination, castration on livestock.
- Women process farm produce using hand operated tools while men use sophisticated equipment.
- Females fetch water for dissolving chemicals while males do the actual spraying using sprayers.
- Men repair farm machinery and do most of the construction work on the farm, women fetch water for construction.
- When using ox cultivation, males holds the equipment while females drives the animal.

- Males plant crops using machinery while females plant using a hoe
- Males apply fertiliser using machines while women apply fertiliser using hands and buckets.

Causes of gender biases in agricultural technology

- Education levels of females is low compared to males hence they cannot understand technology.
- Discriminatory altitude and gender stereotypes: In Malawi society there are gender roles that are socially acceptable so this influence the behaviour of farmers when carrying out their duties.
- Lack of capital/ credit by most females: Most women do not have a collateral hence they fail to buy technological items while men have advantages since they own land which can be used as a collateral.
- Lack of technological information among females due to limited contacts with extension workers as they are burdened with household chores hence they cannot use these technologies.
- Lack of confidence with technological items among females because they don't want to take risks.
- Lack of exposure to role models: There are few older females who use technological items hence females are not encouraged to use technologies.
- Lack of earlier socialisation to technology: Boys are exposed to technologies early through making and playing with cars, aeroplanes while girls play with dolls putting girls at a disadvantage.

Effects of Gender biases in agricultural technology

- Low agricultural production since most females perform farm operations manually hence operations are not efficiently and timely done.
- Low farmers income due to reduced production which results in shortage of surplus to sale.
- Food insecurity due to low yields as a result of not using technologies.
- Increased poverty due to low income levels of people such that they cannot afford basic needs.
- Low rate of national development due to reduced farm output hence government cannot collect enough tax for development.

Ways of dealing with gender biases in agricultural technology

- Put more women on political arena so that they can make decision pertaining to gender parity and involve them in agricultural policy formulation.
- Review land and property ownership laws to enable women to own and control land so that they can use it as a collateral to secure loan and buy technological items.
- Improving access to education by both boy and girl child to reduce illiteracy levels so that all can receive technological information.
- Promote equal skill development for males and females so that each can develop confidence with technologies.
- Reducing women work burden by improving infrastructure e.g. water system so that women can have time to seek technological information instead of spending more time fetching water.
- Enlightening the population on the important contribution women can make in agricultural development and view them as partners in development not as subordinates.
- Discrediting gender stereotypes.
- Developing documentaries of successful women farmers to serve as role models to other female so that can be encouraged to use technological items and develop confidence.

TOPIC 7: IMPROVED FARMING TECHNOLOGY

Improved farming technology refers to the use of new, better, scientific methods of growing crops and raising livestock usually associated with the use of modern equipment and techniques.

Food supply is the availability of food to meet people's needs

Food security is a situation when all people have physical, social and economic access to adequate, safe and nutritious food at all times for an active and health life.

Improved farming technologies that affect food supply
These involves all production technologies that will help farmers to produce more yields

Examples of improved farming technologies that affect food supply

- Crop and animal breeding through hybridisation or genetic engineering technology. (this results in development of superior hybrids e.g. with disease resistance, very high yielding potential etc.
- Agroforestry where by arable crops are grown together with agroforestry shrubs or trees.
- Farm mechanisation e.g. use of tractor drawn implements when cultivating the land.
- Rain water harvesting e.g. storage tanks, mulching, pit planting.
- Irrigation e.g. drip
- Fertilizer, Pesticide and herbicides development.
- Conservation agriculture.
- Feed development e.g. formulation of balanced rations, production of additives like growth hormones, mineral licks.
- Food processing e.g. canning, juicing,
- Soil and water conservation e.g. terraces, pit planting.
- Food storage technologies e.g. cold rooms, metallic silos.
- Animal housing system e.g. battery cage.
- Animal husbandry practices e.g. Artificial insemination.
- Land drainage technologies.
- Temperature modification technologies like hatcheries, brooders and green house.
- Infrastructural development.
- Preservation technology.
- Vertical farming. This is the growing of crops in sky scrapers

Ways in which of improved farming technology ensure food supply

- Development of high yielding, disease resistant crop and animal breeds enable farmers to produce more crop yields and animal products to meet people's needs.
- Agroforestry maintains the lost soil nutrients for high food production to meet people's needs
- Farm mechanisation enables farmers to do farming operations fast and efficient hence high crop production to ensure availability of food to meet people's needs.
- Irrigation enables farmers to grow two or more crops in a year for high production hence more food is available to meet people's needs.
- Conservation Agriculture helps to maintain soil fertility and moisture to ensure high crop yield hence ensuring availability of more food to meet people's needs.
- Feed development resulted in fast growth rate and high livestock products to meet people's needs.
- Pesticide technology prevent crop loses through pest damage this ensures high production to supply more food hence meeting people's needs.
- Herbicides controls weeds for plants to grow without competition for resources hence high crop production to ensure that more food is available to meet people's needs.
- Soil and water conservation maintain soil fertility to ensure high production hence more food is available to meet people's needs.
- Good animal husbandry practices leads to high production this ensure availability of animal products to meet people's needs.

- Land drainage technologies enable cultivation of a wide variety of food stuffs to ensure that food is available to meet people's needs.
- Temperature modification makes it possible to raise crops in green houses when temperatures outside are unsuitable for their growth. Hatcheries and brooders are used in poultry houses to provide suitable temperature for eggs and chicks. These technologies lead to high agricultural production to supply more food that meet people's needs.
- Vertical farming enables cultivation of more crops on a small land and the crops are well protected from weather hence high crop production to supply more food to meet people's needs.

Examples of improved farming technologies that affect food security

- All production technologies mentioned above that affect food supply.
- Food storage technologies e.g. cold rooms or deep freezers, metallic silos.
- Food processing.
- Preservation technology.
- Food fortification. The process of adding micronutrients in the food e.g. adding vitamin A to cooking oil, iodine to salt, breeding crops to increase their nutritional value e.g. genetically engineered rice with beta carotene (Golden rice)
- Infrastructural development technology e.g. efficient road network
- Farm management technology e.g. cell phones, computer
- Food labelling and packaging technology

Ways in which of improved farming technology ensure food security

- Production technologies like fertilisers increases soil fertility enables farmers to produce more food than they need and sale the surplus to urban people hence adequate food for everyone at all times.
- Food storage reduces post-harvest losses due to damage by pests and germs to ensure that food is kept longer and made it available at all times.
- Food processing improve shelf life for people to use at all time.
- Food fortification improves nutritional quality of food to meet People's dietary requirements.
- Infrastructural development technology promote fair distribution of food to all parts of the country to ensure that everyone has access to enough food at all times.
- Use of calculators or computers and cell phones assist in farm management decision in order to increase production and profits. This enables the family afford nutritious food.
- Food labelling and packaging technology provide expire date, storage and preparation instruction so that people are provided with safe and nutritious food at all times.

TOPIC 8: AGRICULTURAL MARKETING AND TRADING

Marketing involves all processes involved in the transformation and flow of goods and services from point of production to the point of consumption. Trading means buying and selling of goods and services to make profit. Marketing and trading both involves transfer of ownership through buying and selling

8.1 Differences between marketing and trading

Marketing	Trading
It involves several marketing functions for the product to reach the final consumer e.g. processing, transportation, storage, selling,	It covers very few functions only buying and selling (exchange function)
It takes consumers at heart(concerned mainly with satisfaction of the consumer)	It solely concerned with the total sales

The channel is wide since it involves many agents	It is not wide as few agents are involved
It is flexible since it changes if consumer needs change. (change in consumer" taste lead to changes in the commodity to satisfy the consumer)	It is not flexible. It seeks to develop stronger sales strategy if consumer needs change. e.g. once goods are bought they are not returnable)
Directs resources of the farm to produce the commodities consumer need	Directs resources to bring about a sale

8.2 Marketing Channels and Agencies

Marketing channels are routes through which goods move from the point of production to the point of consumption. There are a number of functions that are performed in a marketing channel.

Exchange function: Buying and Selling

Physical function: Storage, transportation and processing

Facilitating function: Grading, financing, risk bearing, marketing research and advertising

8.2.1 Types of marketing channels

i) **Direct Marketing Channel (One-tier marketing)**

It is also called one-tier marketing channel. This is a channel where by the producer sells goods and services directly to the consumer. There are no intermediaries involved

FARMER (PRODUCER) ⟶ CONSUMER

Examples of direct marketing channels

- Door-to-door sales;
- Roadside stand;
- Direct sale to restaurants or institutions or neighbours;
- U-pick operations: A consumer will come to the farm harvest himself and pay cash for the produce;
- Community supported agriculture: A consumer will buy shares or sign contact in advance and producers commit to supply products over entire season;

Advantages of direct marketing channel

- The farmer control the price thereby making high profits
- Payment is usually immediate
- Farmer receive immediate feedback from customers on the product and services so that he can improve her business
- It ensure availability of fresh fruits, vegetables, milk at reasonable prices to the consumers

Disadvantages

- It is difficult to locate customers since they are many
- Selling is done slowly

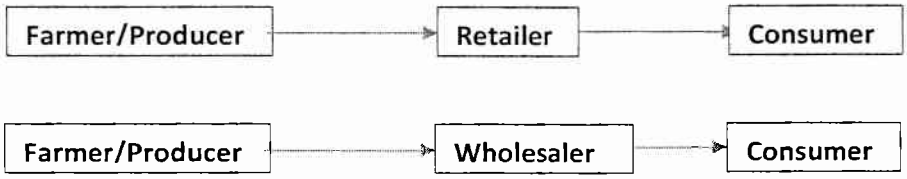
ii) **Indirect marketing channel**

This is the channel whereby intermediaries are used to get the product to the customer. Each intermediary performs a function along the channel and expect a payment. The length of the channel depends on the number of intermediaries.

Categories of indirect marketing channels

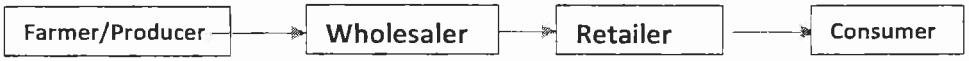
a) Two tier (steps/stages)

This is the type of marketing channel where the farmer sells the product to just one intermediary who later sells it to the final consumer. Two marketing agents are involved in the process e.g. the farmer and the retailer or the farmer and the wholesaler.



b) **Three-tier marketing channel**

The processed commodity is bought by a wholesaler such as Chipiku stores who in turn sells to retailers and finally to the consumer. Three agents handle the produce before reaching the consumer.

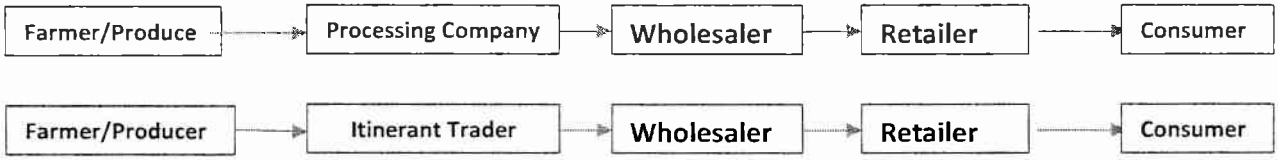


c) **Four-tier marketing channel**

Four agents handle the produce in a four-tier marketing channel

i. The produce is sold to the processing company. Then the processing company sells the products to the wholesalers who sell the products to the retailers then retailers sell to the final consumer.

ii. The itinerant trader buys produce from the farmer and sells to the wholesaler. The wholesaler then sells to the retailer who sells it to the consumers.



Advantages of indirect marketing channel

- It is easy to reach more consumers because the length of the channel has been widened
- It is easy for the existing channel to link up with other producer

Disadvantages of indirect marketing channel: The consumer get the product at a very high price because at every stage a marketing cost is added on the product as a payment to the marketing agent.

iii. Dual distribution marketing channel: This involves more than one channel at the same time to reach the consumer.

iv. **Reverse marketing channel**: This is where there is resale of a product or recycling.

v. **Electronic marketing channel**: This makes use of internet to provide services to the consumer.

Marketing agencies

These are individuals, companies or organisations that carry out various marketing functions. They facilitate the transfer of produce from the producer to the consumer. (Linking producers to buyers)

Examples of marketing agencies and their roles in the marketing channels.

i) **Producer:** This is the starting point of any marketing channel.

Roles performed by the producer:

i) Produce farm produce (bring the products into existence); ii) They sell produce to consumers;
iii) Store the produce to be sold later; iv) Process the farm produce into finished products;

ii) Itinerant traders : These are roving agents who travels (on foot or on bicycles) to various farms to buy farm produce sells to the wholesaler, retailers or final consumer.

Roles performed by the itinerant trader:

i) Assemble farm produce from various farms (bulking); ii) Transporting the produce iii) They sell to the wholesaler, retailer or final consumer

iii) Middlemen: These are people or companies who link the producer with the consumers.

Roles performed by middle men

i) Buy produce from farmers and sell to the consumers;
ii) Assemble farm produce from scattered farms; iii) Transport farm produce

iv) Store the produce; v) Grade the produce vi) Finance production (i.e. giving loans to farmers for production) vii. They provide marketing information to farmers on price of commodities.

iv) Wholesalers
These are agencies who buy farm produce in large quantities and sell in bulk to retailers at a lower price.
The following are some of the roles performed by wholesalers:
i) Buy produce from the farmers or processing companies; ii) Bulking large quantities of products in warehouses; iii) Packaging of the produce; iv) Advertising the products; v) They sell their commodities in bulk to the retailers at lower price; vi) They carry out market research which middlemen can use as they link with the consumers; vii) They bear the risk of price fluctuation, fire, theft;
viii) Conduct market research; ix) Store the produce in warehouse; x) Transport the produce;

v) Processors e.g. Tobacco processors, Rab processors, Nali, Dariboard Malawi Ltd.
i) They buy raw commodity from farmers; ii) Process (transform) the produce into a form to be consumed;
iii) Grade the products; iv) Sell to the consumer or wholesalers;

vi) Marketing boards/companies e.g. ADMARC is an example of a marketing board, Farmers World, Auction Holdings Limited, Alliance One are examples of marketing companies
Roles performed by marketing boards and companies
i) Buy commodities from farmers, itinerant traders, processors or middlemen;
ii) Store the commodities in warehouses; iii) Provide market information to consumers;
iv) Sell commodities to consumers or wholesalers;

vii) Retailers: These are marketing agencies who sale commodities to the final consumer e.g. Metro.
Roles performed by Retailers
i) Buy commodities in bulk from the wholesalers; ii) Assembling (gathering) commodities;
ii) Store the commodities; iv) Transport commodities;
v) Provide information to consumers about prices through advertising, displays as well as receiving information from consumers and direct it to the producers;
vi) Sell products to consumers in small quantities; vii) Conducting or participating in market research;

viii) Marketing cooperatives: These are a group of farmers who carry out marketing functions as a group.
Roles: i) Selling; ii) Transportation; iii. Storage; iv) Grading; v) Processing vi) Financing

ix) Sales agents e.g. Brokers and commission agents: these are middlemen who act on behalf of others. They assist in buying or selling produce at a fee (commission) on behalf of the producers.
Roles of sales agents: i) Selling; ii) Storage; iii; Transports

8.3 THE ROLES OF MARKETING CHANNELS AND AGENCIES

- Linking producers to consumers
- Transport goods to make them available to processors and consumers
- Provide market for the farmers produce
- Provide information to farmers and processors on the needs of consumers
- Store goods to ensure that prices are kept stable (ADMARC)
- Conduct sales promotion by advertising the products
- Conduct market research
- Finance farmer to produce high quality and quantity goods

8.4 MARKETING COSTS AND MARGINS

8.4.1 Marketing Costs

Marketing costs are expenses made by marketing agencies in the marketing channel when carrying out marketing functions. A sources of marketing costs is any activity that is done as the produce move from

point of production to point of consumption e.g. Transportation, Storage, Advertisement, Packaging, Grading, and Displaying. Total marketing costs will be the sum of money paid by marketing agencies in the marketing channel. The greater number of marketing agencies handling the product the higher the costs.

Example: Mr Pire sold 500 bags of maize. He spent K6000 to store the produce waiting for delivery and K5000 to transport the bags to ADMARC. Calculate his marketing costs.

Marketing costs = MK5, 000 + MK6, 000 = MK11, 000

8.4.2 Marketing Margin

This is the difference between cost of buying the produce and selling it to the consumer
Total market margin is the difference between the retailer price (price paid by the consumer) and the farm gate price (Price received by the farmer)

The total market margin includes:
The cost of performing various marketing functions by different marketing agencies
The Profits of various marketing agencies
N/B The longer the marketing channel the higher the consumers are going to pay for a commodity

Example: Mr Pire bought 1 litre of milk from a dairy farmer at k100. He made cheese from the produce and sold it at K300. Calculate the market margin. The market margin = K 300 – K 100 = K200
Contribution of each marketing agency for the final price of the product (retail price) can be calculated using this formula: (Percent share of each marketing agency for the final price) $\frac{Value\ of\ the\ produce\ at\ a\ channel\ level \times 100}{Retail\ price}$

For example: % share of the farmer= $\frac{K9000 \times 100}{K36000}$ N/B figures are taken from the table below
Table below shows marketing agencies at various stages in the marketing channel for 100kg beans. It also shows what each marketing agency does and what each service costs. The new price of beans at each stage and the % share of each marketing agency to the final value of the product (retail price)

Marketing channel level	Charges (Mk)	Price (Mk)	% share
1. Farmer level Farm gate price (Tsangano-Ntcheu)		9000	25.00
2. Itinerant trader(Ntcheu) Cost of a hessian sack Transport cost to Blantyre Trader's profit	 150.00 2850.00 6000.00 9000.00	 18000.00	 25.00
3. Wholesaler level(Blantyre) Grading Packaging Storage Wholesaler's commission	 1000.00 1500.00 1000.00 2500.00 6000.00	 24000.00	 16.67
4. Retailer level (Ndirande) Transportation to Ndirande Displaying and advertising Storage Retailer's profit	 300.00 2400.00 1300.00 8000.00 12000.00	 36000.00	 33.33
5.Price paid by the final consumer (Retail price)		36000.00	

There are four marketing agencies along this marketing channel namely: a) The farmer; b) Itinerant trader; c) Wholesaler and d) Retailer.
The sources of marketing costs include all marketing functions performed by these agencies.
These are: a) Cost of a hessian sack; b) Transport; c) Storage; d) Packaging; e) Displaying; f) Advertising

The total marketing costs = itinerant trader charges + wholesaler charges + Retailer charges
MK9, 000 + MK6, 000 + MK12, 000 = K27, 000

Market Margin Method 1

Retailer price (price paid by final consumer –Farm gate price = **MK36, 000 – MK9, 000 = MK27, 000**
Method 2
Find the sum of the margins at the different stages in the marketing channel.

Stage 1: Between itinerant trader and the farmer K18000 – K9000 = K9000
Stage 2: Between wholesaler and itinerant trader K24000 – K18000 = K6000
Stage 3: Between retailer and wholesaler K36000 – K24000 = K 12000

Then add all the margins to find total market margins= K9000 + K6000 + K12000 = K 27000
Marketing margin is the same as marketing cost. All these are payments made along the marketing channel. Marketing costs are paid by marketing agencies while market margins are paid by the consumers.

8.4.3 EFFECTS OF POPULATION DISTRIBUTIONS ON MARKETING

- It influence the direction of flow of farm produce: Farm produce will be taken to areas with large populations since they offer attractive markets due to high demand.
- It affects the length of markets channels: High populated areas have long marketing channels because there are many agencies.
- It affects the range and form of the product needed: Large populations need a variety of goods to satisfy their needs therefore processing function is done to change the form of produce.
- It affects quality of commodities sold: The products sold in high populated areas are of good quality due to competition among traders in the process of attracting buyers.
- It affects the mode of transport used to take produce to the market: In small populations agents use heads, wheelbarrows, bicycles and oxcarts because the loads are small and more advanced mode of transport are used in high populated areas.
- It determines the prices of goods: Areas with low population density experience low prices of goods due to low demand for marketing.
- It affects the quantity of products required: More products will be taken to areas with high population due high demand.
- It affects the choice of people to target: during product promotion depending on the age, occupation, income, education level, and gender in order to get maximum sales and profits.
- It affects the types of advertising methods used: Mass media (newspapers, radios, and television), trade fairs, exhibition or agricultural shows are more common in highly populated areas since it is easier to reach many consumers at once and product promotion is also cost-effective. In less populated areas, personal selling, door to door is common.

8.4.4 IMPORTANCE OF TRADING AT COMMUNITY LEVEL

- It ensures a constant supply of various commodities to everyone even though they do not take part in the production.
- It promotes specialisation since people tend to concentrate on enterprises they know best and that gives them more profits.
- Traders obtain income by selling their commodities.

- It helps to increase productivity because income act as an incentive to farmers to work hard since they know what they have produced will have a ready market.
- The living standards of people improve due to income obtained from sales.

8.4.5 IMPORTANCE OF TRADING AT NATION LEVEL

- The urban population are able to obtain food through trading.
- It promotes development of local industries through provision of raw materials.
- It creates employment opportunities in which people earn a living.
- It promotes efficient allocation of resources such as land, capital and labour to increase production.
- It promotes specialisation in some enterprises this increase production.
- It promotes food security in a country where by marketing boards buy grain from different parts and keep it national stores to be sold in times of food shortage.
- It enables government and traders to earn income through taxation and selling respectively.

8.4.6 IMPORTANCE OF TRADING AT INTERNATIONAL LEVEL

It enables a country to earn foreign exchange.
It enables the government to obtain funds through tax at point of export or import duty.
It enables consumers to have a wide choice of products from all over the world.
It encourages specialisation in particular enterprises.
It widens the market for the country agricultural commodities this increases production.
It creates pressure on farmers to be more efficient in producing high quality commodities in order to compete internationally.

8.4.7 WAYS OF IMPROVING TRADING OF AGRICULTURAL COMMODITIES

Community level

- Improve road networks for easy access to agricultural commodities.
- Promote rural growth centres (trading centres) where goods and services can be sold or bought.
- Promote peace and harmony among communities so that traders can move without fear.
- Increase productivity in order to have surplus for sale.

National level

- Improve transport infrastructure (road, railways, airways, waterways) for rapid movement of goods
- Improve communication facilities for easy access to market information.
- Promote nation security and political stability so that traders can transact without fear.
- Remove surtax on agricultural commodities.

International level

- Improve transport network for fast movement of goods.
- Promote good international relations so that traders can transact freely across the boarder.
- Promote information communication and technology (ICT) for easy access of goods.
- Reducing or removing trade barriers such as tariffs, import quota, exchange controls and embargo.
- Improving the quality of agricultural products in order to attract buyers.
- Establishing a stable and competitive currency exchange rate to encourage importers to trade.
- Setting reasonable prices relative to those of competitors in order to attract buyers.
- Produce a variety of commodities in order to diversify the commodities available.
- Increase volume of production for export.

TOPIC: 9: PRICE ELASTICITY OF DEMAND AND SUPPLY

9.1 ELASTICITY OF DEMAND

This is the degree of responsiveness of demand to changes in price

Elasticity of demand (Ed) = $\frac{\%\ change\ in\ quantity\ demanded}{\%\ change\ in\ price}$

Example: Calculate elasticity of demand when price changes from K100 to K110 per Kg resulting in a change in the quantity demanded from 5600Kg to 4800Kg.

Elasticity of demand (Ed) = $\frac{\%\ change\ in\ quantity\ demanded}{\%\ change\ in\ price}$

$= \frac{(5600Kg-4888Kg)\times 100}{5600Kg} \div \frac{(K100-K110)\times K100}{K100} = \frac{800Kg\ x\ 100}{5600\ Kg} \div \frac{K10\ x\ 100}{K100} = \frac{80000\ Kg}{5600Kg} \times \frac{K100}{K1000} = 1.43$

The presence of the negative sign indicates that the demand curve slopes down wards from left to right.

9.2 ELASTICITY OF SUPPLY

This is the degree of responsiveness of supply to changes in price

Elasticity of supply (Es) $= \frac{\%\ change\ in\ quantity\ supplied}{\%\ change\ in\ price}$

Example: Calculate elasticity of supply of maize when price changes from K20 to K30 per Kg resulting in a change in the quantity supplied from 40Kg to 80Kg.

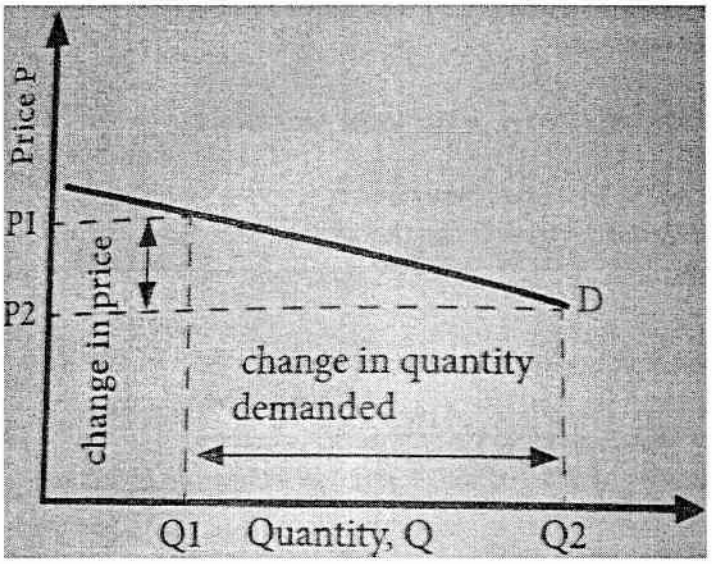
Elasticity of supply $= \frac{\%\ change\ in\ quantity\ supplied}{\%\ change\ in\ price}$

$= \frac{(40Kg-80Kg)\times 100}{40Kg} \div \frac{(K20-K30)\times 100}{K20} = \left(= \frac{40Kg\times 100}{40Kg} \div \frac{K10\times 100}{K20}\right) \frac{4000Kg}{40Kg} \times \frac{K20}{K1000} = 2.0$

9.3 DEGREE OF PRICE ELASTICITY OF DEMAND AND SUPPLY

9.3.1 Elastic demand and Supply (very responsive)

This is the price elasticity of demand and supply which is greater than 1.



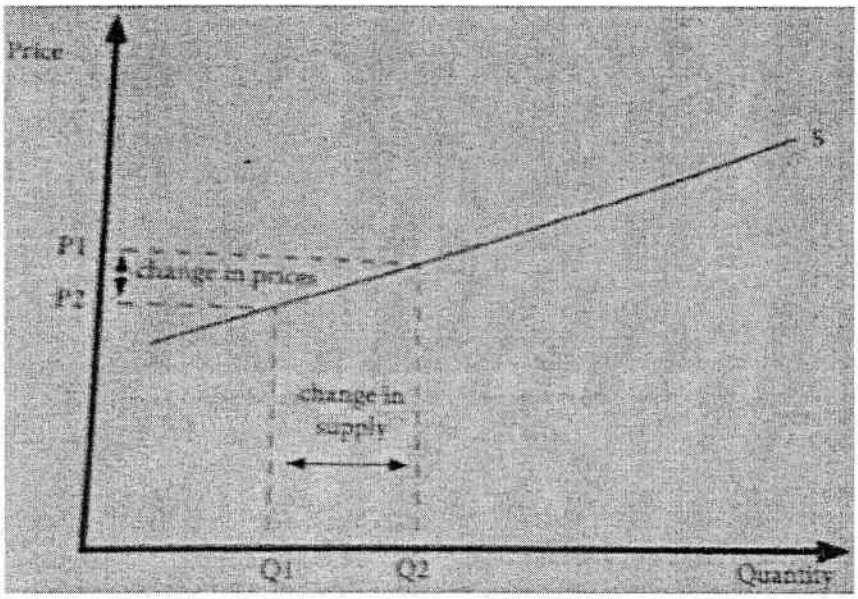
A graph showing Elastic demand

When a small change in price causes a big change in quantity demanded and supplied

When price increases by a certain percentage for example 25% the quantity demanded declines by a far much higher percentage e.g. 55%.

Commodities that have elastic demand: Luxurious commodities for example milk, honey, juice, coffee. Consumers can survive without them. For example when the price of milk goes up there will be a great reduction in demand as people opt not to use milk.

A graph showing Elastic supply



When price increases by a certain percentage for example 30% the quantity supplied increases by a far much higher percentage e.g. 65%.

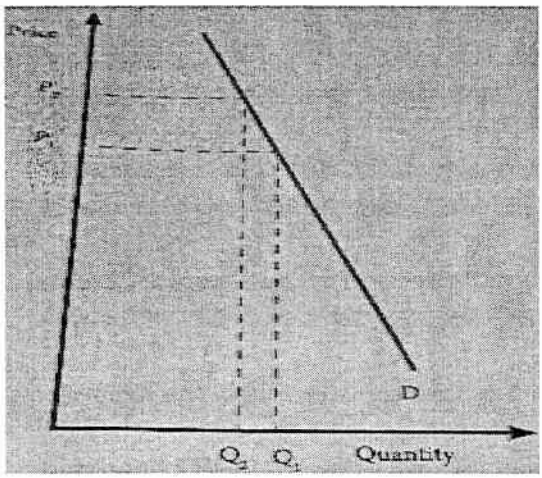
Commodities that have elastic supply: A good example is tobacco a slight drop in prices makes a very decline in supply because many farmers pull out of the enterprise for fear of losing. When price rises many farmers produce and supply more. Commodities that can easily withdraw from the market in case of price fall awaiting a rise in price have elastic supply

9.3.2 Inelastic Demand and Supply (not responsive)

Price elasticity of demand and supply is less than 1

When a large change in price causes a little or no response to quantity demanded and supplied

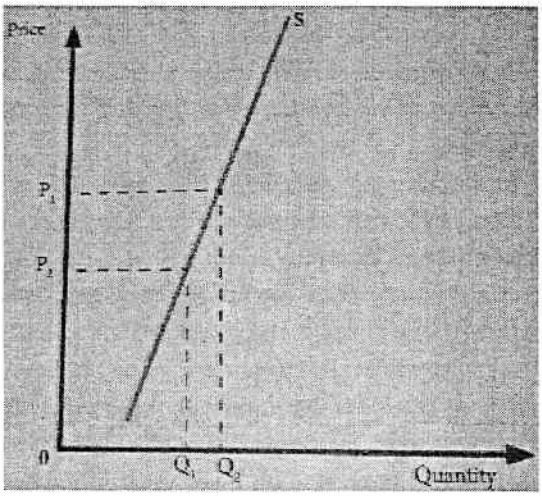
A graph showing inelastic demand



When price increases by 70% the quantity demanded decreases by 10%.

Commodities that have inelastic demand: Maize, rice, cassava sorghum millet, sugar, salt. This situation occurs when consumers have very little choice. A rise in maize prices may not have much change in quantities people would buy because is a staple food crop and people need a certain quantity of these commodities regardless of price

A graph showing inelastic supply



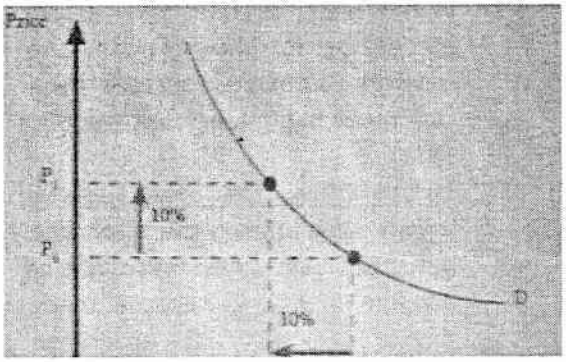
When price increases by 70% the quantity supplied increases by a 20%. Maize is a good example of a commodity with in elastic supply since farmers cannot abandon the crop as they have to produce enough for consumption. Most agricultural commodities have this type of elasticity as most of them take long time to produce.

9.3.3 Unitary Demand and Supply (Response is on one to one basis)

Price elasticity of demand and supply is equal to 1

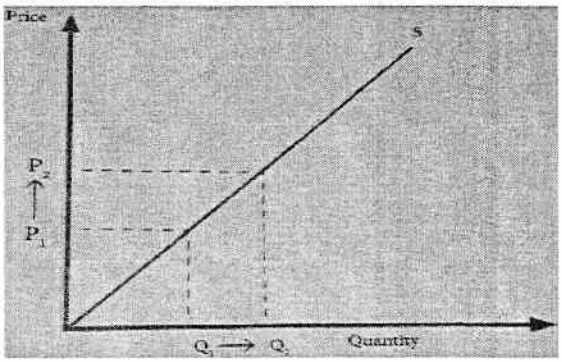
A percent change in the price of a commodity will result in an equal percent change in the quantity demanded and supplied.

A graph showing unitary demand



When price increase by 33% the quantity demanded declines by the same percentage 33%. Commodities that have unitary demand and supply are those products where buyers can get similar alternative (substitute) e.g beans and pigeon peas, cabbage and Chinese cabbage. If price of beans goes up buyers can get pigeon peas.

A graph showing unitary supply



When price increase by 50% the quantity supplied also increases by 50%

9.4 IMPLICATIONS OF PRICE ELASTICITY OF DEMAND AND SUPPLY

- Assist the farmer in making right decision whether to raise or reduce price of commodities. For example, if demand is elastic, lowering prices will increase total revenue since demand will be very high while raising the price will decrease revenue since buyers will go for substitutes (demand will be very low). If demand is inelastic, lowering price will decrease revenue while increasing prices will increase revenue since commodities will be bought regardless of price.
- If the price of a product with elastic demand increases people will buy a related commodity hence increase in demand of the commodity and this also causes producers to increase its supply.
- Soon after harvesting the prices goes down farmers withdraw their produce and store it until when demand will be high leading to an increase in price.
- A reduction in price will increase demand and this will lead to an increase in supply for unitary commodities.
- Farmers remain poor despite of high production. Farmers increase production if prices are high but because of forces of demand and supply prices drops due to inelastic demand as the result their income goes down.
- Government can impose higher taxes on goods with inelastic demand because people have no choice but to buy though the price is high and should impose lower taxes on goods with elastic demand to attract buyers since prices will be low
- International trade: If demand for goods in the importing country is in elastic the exporting country is forced to fix lower prices in order to increase demand.
- If producers are expecting an increase in price due to poor harvest, they withdraw their product to sell later to make a lot of revenue. Even when there is good yield farmers will not sell immediately to avoid selling them at low price.

TOPIC 10: CROP IMPROVEMENT

Crop improvement is the science of changing genetics of plants in order to produce better varieties which are more productive.

10.1 AIMS OF CROP IMPROVEMENT

- To increase quantity of crop yields by raising varieties with high biomass (vegetable or dry matter) through increased growth rate, greater plant vigour and ability to regrow very quickly after grazing in forage crop.

- To improve the ability of plants to divert the biomass to the harvestable part of the plant hence increasing crop yields e.g. leaves (cabbage), seeds (groundnuts) grains (Maize).
- To develop crop varieties that are resistant to pests and diseases for high yield.
- To develop crop varieties that can withstand poor environmental conditions and produce more yields e.g. drought, heavy winds, hail, cold, heat, high soil alkalinity.
- To improve quality of crop yields by developing varieties with high nutritive value e.g. high vitamin, protein content to provide people and livestock nutrients required for growth.
- To develop early maturing varieties to match with the short growing season for high yields.
- To develop dwarf varieties since they can resist lodging and makes harvesting easier for high yields.
- To increase quality of crop varieties by developing varieties with good marketing qualities such as easy to store, good taste and colour, easy to process etc.
- To improve quality of raw materials as demanded by processing companies e.g. ground nuts and sunflower with high oil content.
- To achieve high quality crop yields by developing crop varieties of uniform characteristics in terms of maturity and fruiting time, growth rate, fruit size and shape.

10.1.1 Importance of uniformity in crop varieties

It facilitates mechanisation e.g. harvesting.
It eliminates need for grading.
Crops mature and are harvested within the same period thereby reducing labour, transport costs.

10.2 ACTIVITIES IN CROP IMPROVEMENT

- Collection of germplasm (genetic stock /superior parents) which forms the basic material for crop improvement. It can be indigenous (from farmer's fields or wild species) or exotic.
- Protection of the germplasm from human interference e.g. gene sanctuary, biosphere reserve
- Producing seed banks.
- Breeding superior crop varieties.
- Conducting field evaluation to find out effectiveness of the variety, uniformity and it distinctiveness (should have at least one feature which is different from other varieties)
- Multiplying the seed.
- Registering the varieties and offer an acceptable name.
- Seed multiplication.
- Demonstrations to prove advantage and adaptability of newly developed varieties.
- Seed distribution to farmers for adoption.

10.3 METHODS OF CROP IMPROVEMENT

10.3.1 Introduction

This is a direct method of obtaining crops with superior characteristic by importing them from other countries to serve as a foundation stock for breeding e.g. Ukiriguru Composite A (UCA) a maize variety was brought to Malawi from Tanzania, Malimba, a groundnut variety was brought to Malawi from Gambia.

Advantage	Disadvantage
Superior crop varieties are made available quickly	Some crop varieties may fail to adapt to new environmental conditions They may bring new pests and diseases hence they need to be kept in quarantine to monitoring

10.3.2 Selection: This involves choosing plants with desirable characteristics for breeding or propagation.

Types of selection

i) Natural selection:

A type of selection where by nature takes charge when plants which are fit in the environment survive (survival of the fittest). Plants that survive are used for breeding.

ii) Artificial selection: This is the type of selection which uses human judgement to choose plants with superior characteristics.

Examples of artificial selection

a) Single plant selection/ pure line selection

This involves choosing of plants with desirable qualities among a population of plants.

b) Mass selection

This involves choosing seed of various crops or varieties with desirable qualities for breeding. The seed is planted for next generation. It is also used to determine suitability of an adapted variety in a country. The imported variety is grown and natural selection is allowed to operate.

Advantage of selection

i) It increases frequency of desirable genes; ii) It is used to develop pure breeds (true breeds)

Disadvantage of selection

It does not bring any new desirable traits into the plant but only improving the already existing traits.

10.3.3 Hybridisation

It is also called cross breeding. This involves combination of desirable genes found in two of more different varieties to produce a new variety which is superior to the parents.

Steps of hybridisation

i) Choosing Parents

The breeder choses parental lines with desirable qualities that complement each other for example:

a) A maize variety that is high yielding to be crossed with a low yielding variety that is disease resistant.

b) A high yielder but late maturing to be crossed with a low yielder but early maturing.

c) A high yielding maize variety but difficult to store to be crossed with a low yielder but easy to store.

ii) Self-pollinating the parental lines

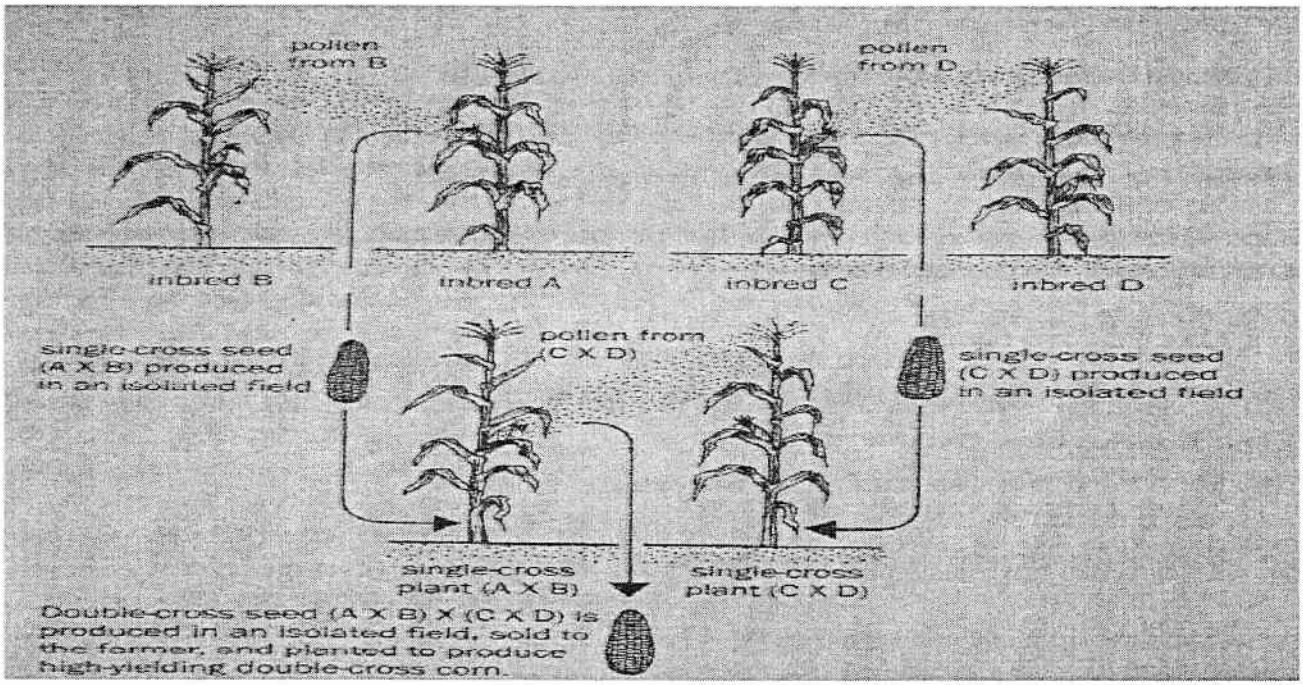
The chosen parents are self- pollinated or mated with a close relative for 5 – 6 generations. This is called inbreeding. It is done to develop pure lines (In breeds)

Advantage	Disadvantage
It results in development of pure lines	It results in inbreeding depression (reduction in plant vigour)

iii) Cross pollinating the pure lines

This involves transferring pollen from one inbred to the other inbred line to produce a hybrid. In case of maize, some of the plants serve as males by saving their tassels while others serve as females by removing their tassels (emasculation) to avoid accidental self-pollination. During harvesting cobs from the female parents will be taken these are the ones carrying genes from both parents. Pollination from any other pollen can be prevented by covering the female part of the flower with a plastic bag then the pollen from a desired plant is transferred manually to that plant. The hybrid can be improved further by increasing the number of inbreds used for crossing e.g. crossing two single cross hybrids (from four inbreds) produces a double cross hybrid.

Advantages of hybridisation	Disadvantages of hybridisation
It results in hybrid vigour (heterosis). Heterosis is the new vigour which the crop acquires through crossbreeding	It is labour demanding



TOPIC 11: CROP PROCESSING

Crop processing means changing of raw form of farm produce into finished products.

11.1 IMPORTANCE OF CROP PROCESSING

- To improve shelf life so that commodities can be kept for a long time and become fit for consumption.
- To add value to the commodities since the produce can be available in different form
- To improve taste of the produce by adding ingredients like flavour, sugar.
- For easy transportation since they become lighter when processed.
- Source of employment in processing industries for people to earn a living.
- Improves the quality of the finished product hence fetches high price at the market.

11.2 PROCESSING OF VARIOUS CROPS

11.2.1 Maize

Maize can be processed when it is green (fresh) or when it is dry

Methods of processing green maize

i) Boiling: i) boiling ready for consumption; ii) Boiling then dried ready to be re boiled later when needed.

ii) Roasting: by stirred up in a hot pan

Processing dry maize

The following are steps involved when processing maize for storage

i) Dehusking: This involves removal of husks of maize cobs.

Importance: i) To speed up drying of maize grains; ii) For easy application of pesticide to the grains.

ii) Shelling: This involves the removal of maize grains from the cobs using machines or hands.

Importance: i) To reduce storage space; ii) To speed up drying process

iii) Drying: This involves spreading of maize grains on a mat, rocks or concrete floors.

Importance: i) Prevents moulds from developing; ii) Help to avoid germination of grains in store; iii) Reduces respiration rate in the grains by keeping temperature low this preserves the grains better;

iv. Makes the testa hard to resist pest damage.

iv) Cleaning: The shelled maize is cleaned by winnowing to remove chaff.

v) Milling/ grinding: The clean shelled maize can be changed into maize flour in a maize mill

vi) Sieving: The milled grain is sieved to separate coarse and fine particles

vii) Boiling and cooking: The coarse particles (grit) are boiled to cook soft porridge (phala) and flour can be used for cooking hard porridge (nsima)

viii) Storing maize grains or flour
The shelled and dried maize grains can be sprayed or dusted with pesticides and packed in sacks, tins silos baskets or drums. Maize flour can also be stored in sacks or tins.

Qualities of a good storage facility

- Must be dry/ have a leak proof to prevent moulds.
- Must be cool to prevent grains from heated and get spoilt due to increase in respiration.
- Must be clean to avoid multiplication of pests.
- Must be air tight / must not have holes or cracks to prevent rats from entering the store.
- Must have strong walls to avoid thieves.

11.2.2 Groundnuts

Groundnuts can be processed while when fresh or dry

Procedure for processing fresh groundnuts

- Cleaning: by washing them in water
- Boiling
- Drying: The boiled groundnuts can be dried by spreading them on mats for future use

Procedure for processing dried groundnuts

i) Roasting:

Two ways of roasting groundnuts

a) Dry roasting

Procedure: i) Put them on dry pans; ii) Heat the nuts in a pan and stir to promote an even roast; iii) Cooling iv) Blanching the nuts; iv) Removing the testa

b) Oil roasting

Procedure: i) Blanching (groundnuts are immersed in hot water and then cold water); ii) Heat the nuts in hot oil; iii. Cooling

ii) Pressing: This is done to extract oil from the nuts

iii) **Crushing:** This is done to produce peanut butter. Procedure: i. Roasting ii. Crushing.

iv) **Pounding or milling**: This is done to obtain groundnut flour.

11.2.3 Mangoes

Ways of processing mangoes
Mangoes can be processed while still green (unripe) or when ripe.

i) Processing unripe mangoes
Mangoes can be processed into pickles or chutney

Making Pickles
Procedure: i) Wash unripe mangoes; ii) Peel them; iii) Remove stones (seed) iv) Slice them
v. Add chili powder, black pepper, cardamom, cinnamon powder,

Making chutney

Procedure: i) Wash unripe mangoes; ii) Peel them; iii) Remove stones (seed) iv) Slice them
v) Add ingredients like sugar, salt, chopped onion, chopped garlic, chopped ginger, red chili powder, black pepper, cardamom, cinnamon and vinegar

ii) Processing ripe mangoes

(a) **Canning:** This is the process where mangoes are put in sealed or air tight containers.

Procedure

- Select fruits that are in good condition;
- Wash them thoroughly;
- Peel the fruits;
- Slice them into small pieces;
- Dip them in ascorbic acid/lemon juice/vinegar to preserve colour, flavour and texture of mangoes;
- Place the sliced fruits in sterilised metal cans or glass jars and close and seal them tightly;
- Sterilizing them with steam or heating the cans in boiling water;
- Remove the cans from the heat and allow them to cool;
- Label them to show their contents and date when canned;

b) Freezing: This involves putting mangoes in a freezer where temperature are below 0 degrees Celsius so that microorganisms become inactive.

Procedure
i) Select mangoes in good condition; ii) Wash them thoroughly; iii) Put them in a plastic bag;
iv) Place the bags in the freezer.

c) Pulping: The process of extracting pulp from the fruits. Pulp a highly concentrated mango juice. The pulp can be used to produce mango juice, mango jelly, mango squash, mango cheese and jam

Procedure
i) Select fruits that are in good condition; ii) Wash them thoroughly; iii Peel the fruits; iv) Slice them into small pieces; v) Press them to extract juice, vi) Pasteurising pulp. (Boiling and cooling before or after bottling to sterilise it); vii) Storing in bottles

d) Making Jam
Procedure:
i) Mix mango pulp and sugar; ii) Add citric acid; iii) Boil the mango pulp mixed with sugar till jam consistency is reached; iv) Fill the sterilised bottles with hot jam then cool and store

11.2.4 Mushroom

Ways of processing mushroom
a) Canning Procedure: (same as canning of mangoes)
b) Freezing: Procedure: i) Wash mushrooms; ii) Sliced; iii) Blanched by dipping them in boiled water; iv) Cooling; v) Packed in plastic bags; vi) Stored in a cold room;

c) Sterilisation: Procedure: i) Wash mushroom thoroughly; ii) Slice them into small pieces; iii) Blanching iv) Salting; v) Steam or heated them to kill microorganisms; vi) Drying

d) Drying: Procedure: i) Blanching ii) Drying in the sun/oven/vacuum/microwave.
iii) Packing in air tight bags and store them on shelves

e) Salting: Procedure: i) Blanching; ii) Dipping them in salt solution; iii) Drying; iv) Packing them in air tight bags and store them on shelves

e) Pounding/ milling into powder

Procedure: i) Drying; ii) Pounding or milling Pounding or milling; iii) Packing and storing;

f) **Pickling of mushrooms**

Procedure: Procedure: i) Mix White wine, vinegar, salt, sugar, garlic and olive oil and water; ii) Boil them; iii) Add mushrooms to the mixture; iv) Boil them for 15 minutes; v) Drying the mushroom; vi) Coat the dried mushroom with olive oil; vii) Packing and storing.

11.2.4 Vegetables

Ways of processing vegetables

a) Drying Method (Dehydration)

Procedure

- Wash the vegetables thoroughly
- Chop them into smaller pieces
- Blanching by placing them in boiling water or in steam for 2 minutes. This ends enzymatic reactions in the leaves to retain the colour and flavour and kills microorganisms.
- Drying the blanched leaves on mats or in oven, vacuum or microwave and store them in packs;

(b) Freezing method

Procedure:

i) Wash the vegetables thoroughly; ii) Place the vegetables in boiled or steam for 2 minutes.
iii) Wrap the leaves in moisture proof and air tight packets to prevent oxidation.
iv) Place the packs in a freezer;

c) Canning method

Procedure: i) Cut vegetables into pieces; ii) Blanching; iii) Packed in sterilised metal cans and sealed;
iii) Put through severe heat treatment (sterilisation) to kill microorganisms; iv) Cooling them;

TOPIC 12: PASTURE PRODUCTION

Pasture refers to land covered with grass, legumes and other plants growing naturally or planted for feeding livestock.

12.1 Importance of pasture

- Provides a cheapest source of feed for ruminants.
- Leguminous pasture maintains soil fertility by fixing nitrogen into the soil.
- Pasture controls soil erosion by providing a soil cover that break the force of raindrops to prevent splash erosion and reduce the speed of run off. Fibrous roots of grass pasture bind the soil particles
- Pasture improves soil structure when the roots and leaves die and decay the organic matter provides a cementing agent which bind soil particles hence promoting soil aggregation.
- Pasture grasses in crop rotation helps to control pests and diseases by breaking their life cycles e.g. love grass and Katambola Rhodes grass are used in tobacco rotations to control eelworms.

12.2 Types of pasture

i) Indigenous (natural) pasture

Indigenous pasture is an uncultivated land such as dry lands or dambo in which indigenous species are dominant.

Examples of natural pastures (indigenous pasture): Thatching grass; Rapoko grass; cat's tail grass

ii) Exotic pastures

These are cultivated (man-established) pasture and they include at least one improved species of grass or legumes. If only grass or only legumes are grown, then the pasture is referred to as a pure stand of grass or legume. If grasses or legumes are grown together then pasture is referred as a mixed stand.

Advantages of pure stand: i) It is easy to control weed using chemicals; ii) It is easy to collect seeds;

Disadvantages of pure stand

i) In case of crop failure the farmer has nothing to rely on; ii Low yield per unit area;

Advantages of mixed stand

i) It has high nutritive value; ii) In case of crop failure the farmer can depend on the other crop;
iii) It is more palatable than a pure grass stand;
iv) The combined yield from grasses and legumes is higher than in a pure stand;
v) The nitrogen fixed by legumes are used by the grass pasture to increase its yield;
vi) Legumes are more palatable, have high nutritive value and digestible even when mature in the dry season;

Disadvantages of mixed stand:

i) It is difficult to control weed using chemicals; ii) It is difficult to collect seeds;

Examples of exotic pastures (improved pasture)

a) Exotic pasture grasses: Rhodes grass; Buffel grass; Napier grass; Guinea grass
b) Exotic pasture legumes: Stylo; Centrosema; Desmodium; glycine; Joint vetch
c) Leguminous shrubs: Leucaena (*Leucaena leucocephala)*; Faidherbia albida (Msangu)

12.3 Classification of exotic pasture

i) Permanent Pasture

This is cultivated (planted) pasture that contains at least one exotic species of grass or legume and managed for 10 – 15 years.

Examples: Star grass (cynodon dactylon), Bushman Mine Panic grass, Buffel grass, Torpedo grass

ii) Temporary pasture

They are also called leys. These are cultivated pastures lasting 3-5 years

Examples: Rhodes grass, Guinea grass, Love Grass, Napier grass and setaria

Advantages of improved pastures (exotic) over natural pasture

- They have higher digestibility regardless whether they are grass pasture or legume pastures or whether the pastures are still young (in wet season) or mature (in dry season).
- Exotic pastures have a higher dry matter yield than indigenous pasture because they have a longer period of growing before they flower (hence more productive than indigenous).
- Exotic pastures have higher protein content and they retain high levels of protein when mature. This makes legumes very important sources of protein during dry season.
- They remain palatable and easy to digest for a long time as they take more time to mature.

12.4 METHOD OF PASTURE ESTABLISHMENT

12.4.1 Broadcasting

This involves spreading seed on the soil surface using hands or seed broadcaster machine. The seed is then covered with soil. The seed can be mixed with sand, saw dust or fertiliser before spreading.

Advantages:

- It is the fastest way of sowing seed hence saves time.
- It does not require a lot of labour hence low labour cost.

- It is easiest way since not as much skill is required

Disadvantages:

- It is difficult to weed and apply fertiliser because plants grow without a pattern.
- It results in uneven plant growth as many seeds can fall in one area and fewer seeds in another.
- Seed is wasted as some seeds may not be covered with soil and can picked up by birds or carried away by running off water.
- It requires a lot of seeds as some seeds may fail to germinate hence high seed cost.
- It results in low germination percentage as seeds may be covered too deep and fail to germinate while those on surface may not receive enough moisture.

12.4.2 Drilling

This involves placing seeds in drills made by sticks, hoes or machinery then covered with soil.

Advantages

- It is easy to use machines, apply fertiliser or weed since plants grow following a pattern.
- Seed wastage is prevented since it is covered adequately with soil and cannot be picked up by birds or carried away by running off water.
- It results high germination percentage as seeds may be is adequately covered with soil.
- It reduces pasture trampling since the space between rows act as a path for grazing animals.

Disadvantages

i) It is time consuming if done by hand; ii) It is expensive if done mechanically;
iii) Skill is required if done mechanically; iv) It is labour demanding when done manually

12.4.3 Under-sowing

This involves combining pasture and an arable crop on the same piece of land. Pasture is planted after an arable crop is well established e.g. love grass in a maize field. The arable crop becomes a nurse crop.

Advantage

- It eliminate the cost of land preparation for the pasture crop because weeding for the arable crop clears land for planting pasture;
- It enables the farmer to harvest an extra crop from the plot;
- The arable crop provides shade to the pasture so that it may not wilt soon after planting;
- Leguminous pasture fix nitrogen in the soil for the benefit of the arable crop;

Disadvantage

i) The yield of each crop is less than if it were planted in pure stands due to competition for resources;
ii) It requires skill in combining the two crops to reduce competition;
ii) It is difficult to harvest the main crop when the pasture is overgrown;
iv) The under sown pasture may be damaged during harvesting of the nurse crop;

12.4.4 Over- sowing

This involves planting pasture into an already existing pasture land. It is called sod seeding. Before sowing the existing pasture species need to be reduced by burning, heavy grazing or slashing.

Advantage

i) It improves composition of existing pasture by introducing better pasture species hence high nutrient content, palatability, digestibility and dry matter yield of the pasture improve;
ii) There is reduced labour since operations are done together;
iii) The existing pasture protects the seedlings from direct sunlight;

Disadvantages

i) The introduced pasture may face competition for sunlight and nutrients from the already established pasture unless the original pasture is reduced by burning;

ii) It requires skill to manage all species on one land;

12.4.5 Vegetative propagation

This method involves use parts of a plant to establish new plants e.g. star grass can be established using stem cuttings while Napier grass can be established using stem cuttings.

Advantages

- Pasture gets established easily since vegetative organs have sufficient food reserves;
- The problem of seed dormancy is avoided;
- Vegetative organs are hard and able to withstand environmental hazards in the field;
- It is cheap because planting materials are readily available from previous harvest;
- There is genetic uniformity as all plants resemble their parents;

Disadvantages

- Vegetative materials are bulky hence difficult to transport to the field;
- There are risks of transferring diseases to new plants is high;
- It is more difficult introduce variation into the crop making crop improvement more difficult;
- It is very difficult to store planting materials since they lose their viability fast;

12.5 SEED RATE

Seed rate refers to the amount of seeds required per hectare.

Seed rate = $Expected\ plant\ population\ per\ hacter \div seed\ size \div germination\ \% \div Purity\ \%$

Example: Calculate seed rate for buffel grass with a seed size of 300000 seeds per kg, Purity 80%, Germination 30%, and Expected plant population of 900000 plants.

Calculations:

Seed Rate= $Expected\ plant\ population\ per\ hacter \div seed\ size \div germination\ \% \div Purity\ \%$

$$= \frac{900{,}000\ plants \div 30{,}000\ seeds \div 80 \div 30}{hactare \quad 1\ Kg \quad 100 \quad 100} = \frac{900000\ plants \times 1\ Kg \times 100 \times 100}{300000\ seeds \times 80 \times 30} = 12.5\ Kg / ha$$

Factors affecting seed rate of pasture

- Seed size: Pasture with small seeds are sown at lower seed rates than those with large seeds because there are many seeds per kilogram.
- Soil tilth: – seed rate should be reduced if the seed beds are well prepared to a fine tilth since more seeds will germinate.
- Growth habit of the pasture: Species with large vegetative growth or which produces more shoots should be sown at a lower seed rates in order to reduce shading.
- Method of sowing: Broadcasting method require more seeds than drilling because it results in reduced germination or survival of seedlings.
- Germination percentage: the higher the germination percentage the lower seed rate required since more seeds will germinate.
- Purity of the seed: The lower the purity percent the higher the seed rate required since the seed is mixed with foreign materials such as weed seeds, husks and seed of other plants.

12.6 METHODS OF PASTURE SEED TREATMENT

Seed treatment is the process of handling planting materials (seeds) to promote successful establishment.

i) Hulling: This is the removal of the pods around the seed in leguminous pasture. A traditional pounding mortar can be used. Winnowing follows hulling to remove chaff.

Importance

i) It makes pelleting of the seeds easy; ii) It increases the rate of seed germination;

iii) Ensures a more even seed distribution of broadcast seed;

ii) Scarification: This is the process in which the hard testa of pasture seed is weakened. This can be done by immersing seed in hot water or acid for few minutes or by scratching the testa to remove it using machines.
Importance: To speed of water penetration into the seed for fast seed germination.

iii) Inoculation - This is the process of mixing legume seed with the correct type of rhizobium bacteria.

Importance: This encourages nodule formation hence promoting nitrogen fixation.

iv) Pelleting: This is the practice of sticking a thin layer of materials like lime, gypsum or rock phosphate around the legume seeds. Gypsum increases soil acidity this may inhibit activities of rhizobium bacteria making inoculation unsuccessful hence inoculated seed should not be coated with gypsum.

Importance

i) It enables seeds to germinate in soils with unfavourable soil pH or with nutrient deficiencies;
ii) It protects the seed from pathogens; iii) It increases the size of very tiny seeds for easy planting;

Proper time for pasture establishment: The crop should be planted at the onset of the rains for successful establishment.

12.7 PASTURE ESTABLISHMENT PROCEDURE

i) Land preparation

The land is cleared, ploughed and large clods of soil are broken to make fine tilth. This should be done early in the dry season. The smaller the seed size the finer the tilth of the seed bed.

ii) Planting pasture: For successful pasture establishment the following should be done;

- Plant pasture at the onset of rains
- Apply manure or phosphatic fertiliser.
- Plant quality seeds (certified seeds). Seed quality is expressed as the pure line seed content (PLSC)

PLSC = $\frac{purity\ \% * germination\ \%}{100}$ N/B The higher the figure the higher the seed quality

Qualities of a good seed

i) Must be viable; ii) Free from pest and diseases; iii) Must be adaptable to the ecological conditions;

iii) Pasture management

This means caring for established pasture. Activities involved in pasture management include:

(a) Applying the correct type and amount of fertiliser

Type of pasture	23:21:0+4 s (kg/ha)	CAN (kg/ha)	Super phosphate(kg/ha	Potassium Sulphate kg/ha)
Pure grass ley or permanent pasture	100	100-200		
Cut and carry grass	100	100-200		100
Grass/legume mixture		85		
Pure legume			100	

Grass pasture should be applied with nitrogenous fertilisers to promote vegetative growth. Pure legume pasture should be applied with phosphatic fertilisers to promote nodulation and nitrogen fixation. Cut and carry should be applied with potassium fertilisers since removing fodder depletes soil potash.

Method of fertiliser Application

i) Basal dressing: This is done during planting using 23:21:20:+4s to pure grass pasture.

ii) Top dressing: This is done when pasture is established using CAN for grass pasture while cut and carry with Murite of potash.

(b) Controlling weeds – weeds should be removed as soon as they appear.

Methods used

i) Mechanical weed control (hoeing, slashing, mowing); ii) Uprooting by hand (physical weed control) iii) Spraying chemicals (chemical weed control);

Reasons for Weed control

- To prevent competition with pasture crop for resources
- To prevent livestock from being poisoned since some weeds such as Sodom apple are poisonous.
- Some weeds taint the colour and flavour of milk e.g. wild onion

(c) Controlling pests and diseases

Diseases can be controlled by rogueing off infected plants. (Removing by uprooting)

Common pests	Control
Army worms & elegant grasshopper	Spray carbaryl
Termites	Spray dieldrine
Aphids	Spray malathion
Moles	Trapping, flooding and use of rodenticides

(d) Controlling burning of the pasture in the dry season

This management activity is done on natural pasture at the end of the dry season

Advantages

- It controls pests, diseases and parasites by sterilising the soil.
- It removes dry inedible herbage so that fresh pasture can grow out more freely.
- It reduces competition for resources between selectively grazed palatable species and ungrazed unpalatable species by destroying them with fire.
- Prevent woody shrubs from inhabiting the pasture thus avoid prevents bush encroachment
- It controls weeds some of which may be poisonous to livestock

Disadvantages

- It destroys the legume component of the soil since they are more easily destroyed by fire.
- It may reduce plant vigour if heat is not controlled as it burns off the root stock which provides food energy to developing shoots.

(e) Grazing animals on the pasture land

Grazing management involves grazing animals on pasture in order to obtain high levels of livestock without causing sward degeneration. Grazing should be done between 4-6 weeks after establishment depending on the species and thereafter at an interval of 4-8 weeks. Very young pasture tend to have low dry matter yield and low nutrient content. Overgrown pasture becomes too fibrous, less digestible and less palatable.

12.8 PRINCIPLES OF GRAZING MANAGEMENT

i) Controlling stocking Rate

Stocking rate is the number of animals of a specified type grazing on a unit area. It must be matched with pasture carrying capacity. Overstocking leads to overgrazing and it happens when stocking rate is higher than pasture carrying capacity. Understocking leads to under grazing and it occurs when stocking rate is lower than pasture carrying capacity. This leads to wastage of pasture, selective grazing of palatable species leaving unpalatable species.

ii) Matching grazing to pasture carrying capacity

Pasture carrying capacity is number of animals that can be grazed on a given area of pasture throughout the year without causing pasture destruction and wastage.

The carrying capacity of pasture depends on its yield potential and quality.

iii) Proving sufficient grazing interval (rest period)

This is the period when pasture is not grazed

The rest period should be enough to allow pasture to recover but should not should not be too long to ensure that pasture is still young enough, tender, juicy and palatable.

If grazing period is too long, the pasture become over mature, fibrous and indigestible.

12.9 GRAZING SYSTEM

i) Zero grazing/cut and carry/stall grazing system

This is a system where by pasture is cut and transported daily for feeding animals in stalls where they are kept in total confinement.

Advantages

- It is easy to control parasites and diseases since animals do not move to graze.
- It prevents selective grazing i.e. there is 100% utilisation of pasture since animals are forced to eat all that is cut.
- It prevents overgrazing since the pasture is given enough time after successive cuts.
- It allows animals to gain weight since they do loose energy in search of feed.
- It is easy to collect manure.
- Animals are protected from predators and bad weather.
- It facilitates close observation of animals on heat.
- It avoids trampling of pasture since animals are not moved onto the pasture.
- There is little land space requirement that is it allows high stocking rate.

Disadvantages: i) It is labour intensive during cutting and transporting the herbage daily;
ii)High initial capital is required to establish and put up animal stall/pens;

ii) Rotational grazing system

It refers to the practice of grazing livestock on a part of pasture for some time down to a certain level after which animals are moved to another part of pasture in an orderly manner such that by the time the animals return to the first part, the pasture will have generated.

Methods of rotational grazing

a) **Paddocking**: A paddock is a fenced portion of pasture in which animals are confined for grazing. In this system, animals move at regular intervals around a series of paddocks so that each paddock has a period of grazing and a period of rest for pasture to recover. A grazing period of 2-4 weeks and a rest period of four weeks are ideal.

b) **Herding**: A system of grazing where by a herdsperson controls grazing of animals by confining them to an area of pasture for some time then moving them to another part when the grass level drops.

c) **Tethering**: This involves tying an animal to a post with a rope such that the animal feeds within a restricted area for some time then moving it to another part.

Advantage of rotational grazing

i) It controls soil erosion because overgrazing is avoided; ii) It controls parasites by breaking their life cycles; ii) It provides enough time for pasture to recover to ensure availability of feed throughout the year;

iii) Prevents selective grazing as animals are forced to eat within a paddock;

iv) It allows management practices on un-grazed part e.g. fertiliser application, weed control, etc.

v) It prevents selective grazing hence allows maximum utilisation of pasture;

Disadvantages: i) It requires a lot of capital for fencing; ii) It requires large land;

iii) Strip grazing system: It is a system where by animals are confined to a very small fenced area of pasture and allowed to graze for a day then moved to another fresh strip/area. An electric fenced is used. This is a môre intensive from of rotational grazing.

Advantages

i) It is ensures availability of high quality pasture each day as pasture is eaten when it is fresh.
ii) It reduces wastage of pasture since animals may not have chance to select;
iii) It provides enough time for pasture to recover to ensure that feed is available throughout the year;
iv) It controls parasites by breaking their life cycles;

Disadvantage: i) It is expensive to fence the small strips since it require an electric fence;
ii) Source of electric power may not may not be available everywhere;

iv) Continuous grazing system : This is a system of grazing in which animals are placed on a pasture for prolonged periods without allowing pasture to rest. This is done in communal land e.g. dambo land where everyone is free to place any number of livestock on the land.

Advantages: i) It is cheap since it does not require fencing;
ii) It is less involving since does not require to move animals from one part of pasture to another;

Disadvantages

- Parasites build up since the system allows them to complete their life cycles;
- Pasture is not given time to recover hence leading to scarcity of pasture;
- It causes overgrazing since stocking rates are not observed as everyone is free to place any number of livestock on the land;
- It leads to trampling of pasture because of too many hooves stepping on the pasture;

v) Deferred grazing system: It is a grazing system in which pasture is allowed to mature and is left standing to be grazed during dry season.

Advantages

i) Prevents animals from contracting liver flukes; ii) It ensures the availability of feed during dry season.

Disadvantage: Pasture becomes over-mature, fibrous less digestible, less nutritious and less palatable.

12.10 PASTURE CONSERVATION

This is the practice of preserving the excess forage crop for future use.

Importance of pasture conservation

i) It ensures availability of livestock feed throughout the year; ii) It is a source of income after selling.

Methods of pasture conservation

1. Hay making 2. Silage making 3. Foggage

i) Hay making

Hay refers to forage crops which have been cut and partially dried to about 15 – 20 % moisture content.

Good quality hay is clean, dry at 20% moisture content and is free from foreign matter.

Procedure:

- Cutting: - the forage used for hay should be cut just before the plants flower, in order to obtain the most nutritious and palatable products.
- Drying: - the cut grass should be partially sundried for three days to a moisture content 15-20%. Over drying reduces the carotene content (vitamin A) and lowers the quality of the hay.

- Stacking:-the cut, partially dried grass is baled (compressed) or stacked (loosely piled) in a shed with a leak-proof roof.

Advantage of hay	Disadvantages of hay
It does not require much skill to make hay; It does not require much labour;	Drying period depends on weather; Some pasture species may not be preserved as hay because they tend to be course, unpalatable and leaves shatter when dry; The pasture loses a lot of vitamin A during drying process;

b) Silage making

Silage is cut forage which is anaerobically fermented and preserved when they are green and fresh
The process of silage making is called ensiling and the structure where it is prepared is known as a silo.

Procedure for silage making

- Cutting: The forage is cut just before flowering. Legume forage can be cut at podding stage.
- Partial drying: Dry the cut forage to a moisture content of about 65% to maintain its succulence.
- Chopping: The partially dried forage is cut into smaller pieces to assist compression/compaction and to increase the quantity or volume of grass that can be put into a given pit silo.
- Stacking: Place the chopped forage in a pit silo or tower silo in layers. This is done quickly to eliminate air. Each layer of forage is mixed with energy concentrate e.g. molasses to provide energy for bacteria in the silo. Other additives can be included to improve the quality of silage.
- Compressing: - The forage in the silo is firmly compacted (pressed) to push out oxygen
- Air tight sealing: Cover the ensiled material with a polythene sheet, soil or a layer of dry grass to make it air tight. Any remaining air in the silo is used up by aerobic bacteria until there is no more oxygen and the bacteria die.
- Fermentation: anaerobic bacteria ferment the forage. Carbohydrates and sugar are broken to produce lactic acid heat. Lactic acid gives silage a pleasant smell and a nice taste, it preserves the silage and it lowers the pH in the silo to about 4. The heat and the low pH kill the anaerobic bacteria and prevent further multiplication. This preserves the silage.

Advantage of silage

i) It has high feeding value since less vitamin A is lost than in hay.
ii) It maintains the succulent (juicy) state of the green fresh forage hence it is highly digestible.
iii) It is free of weed seeds since they are killed by heat in the silo.
iv) It is more palatable than hay and has better smell because of the lactic acid.
v) It is better preserved and can be kept for longer.
vi) It uses a wider variety of forages, including those that cannot be made into hay e.g. Napier grass.

Disadvantages

i) It is labour intensive; ii) Silage is more expensive to make because it requires a lot of materials.
iii) It must be fed soon after removal from the silo or else it spoils; iv) It requires high level of skills to prepare it;

c) Foggage: This is standing hay, left un-grazed for use in the dry season.

Advantage of foggage: It is a cheap method

Disadvantages: It reduces quality of herbage since it is mature with more fibre, low digestibility and low crude protein content.

12.11 FACTORS AFFECTING QUALITY OF CONSERVED PASTURE.

- Leafiness of pasture: The fodder which is leafier is of high quality since leaves contain more nutrients and are more palatable and more digestible than stems.

- Age of the crop at cutting: The younger the pasture the more nutritious, digestible and palatable and therefore the higher the quality.
- Presence of foreign materials: weeds, poisonous plants, and presence of foreign materials like pieces of wire or nails lowers the quality because they are dangerous.
- Moisture content: hay with high moisture content lowers its quality since it will turn mouldy and will decompose and very dry hay will break during handling hence low quality.
- Methods of storage: leaking or wet storage facilities lower the nutritive value of hay due to development of moulds hence low quality.
- Rainy weather condition: Causes leaching of nutrients & development of moulds hence low quality due to loss of nutrients. Rainy weather also lengthen period of drying hence loss of nutrients through volatilisation. N/B Hay must be prepared when then sun is shining.
- Pasture species: Conserved pasture that contain more legumes than grasses or that contains improved (exotic) pasture grasses is of high quality pasture because it contains higher crude protein content and are more digestible and palatable.

TOPIC 13: MANGO PRODUCTION

13.1 IMPORTANCE OF FRUITS

A: **Economic Importance:**

- Fruits are sold to earn income;
- Fruits are exported to earn foreign exchange;

B. **Social Importance**

- Fruit tees provide shed for people to sit under the tree while resting.
- Fruit trees prevent soil degradation as their roots bind soil particles.
- Fruit trees have medicinal value to cure some illnesses.
- Fruit trees purify the air that we breathe as they take in carbon dioxide and release oxygen.
- Source of employment in marketing of fruits in order to improve their living standards.
- Fruits are offered as a gift to friends and visitors.
- Fruit trees can be a source of wood once they become unproductive.

C: **Nutritional Importance**

They contain nutrients such as vitamins and minerals to protect people from diseases and carbohydrates for energy. Fruits contain water therefore help to keep our body hydrated. Fruits contain fibres which help in digestion to avoid constipation.

13.2 MANGO VARIETIES

13.2.1 Local varieties

Boloma, Domasi and Dodo. These three local varieties are big in size and sweet.
Waka, kapantha and kambulutu are small in size but with good flavour.
All local mango varieties are fibrous (the flesh is stringy) therefore not acceptable at the world market.

13.2.2 Improved varieties

These varieties are good for export since the flesh is free from strings or fibres. During ripening they tend to be well coloured with a red to purple blush colour.
The following are some of the examples of improved mango varieties and their characteristics

Variety	Characteristic	Variety	Characteristic
Haden	Large in size 400-700 grams Suitable for hot dry areas Early season variety Susceptible to anthracnose Oblong in shape Excellent flavour Purple colour which become lighter when ripe	Davis Haden	It is larger than Haden 900 grams A mid-season variety Resistant to anthracnose
Zill	It is medium in size 300-400 grams Oval in shape Has rounded base and apex The fruit fresh is yellow It is an early season crop Has a sweet smell and strong aroma	Irwin	Early season crop It is medium in size up to 450 grams It is elongated 12 cm long It is oval in shape and slightly flattened Orange in colour with dark red blush Early season variety Suitable for most areas in Malawi
Kent	Large fruit up to 900g; Late season variety; Suitable for hot areas; Oval in shape; The fruit turn greenish yellow with red blush colour as they mature;	Keitt	Large, plump and thick fruit up to 900g; Oval in shape with rounded apex; Green skin with light red blush and the flesh is orange to yellow; Disease resistant; Very late season variety;
Anderson	Very large in size up to 1kg; 28 cm long; Thick skin; Green to yellow colour with crimson blush; Suitable for canning;	Palmer	Large fruit 600-700 grams; Susceptible to bacterial black sport; Late season variety; Elongated fruits; Orange to pink in colour;
Tommy Atkins	Small to medium sized; Very sweet It is purplish in colour; It is medium sized; It has a long shelf life;	Apple	Medium to large; Yellow or orange to red in colour when ripe; Susceptible to anthracnose and powdery mildew;
Van dyke	Small to medium size; Oval in shape; Orange yellow in colour with pleasant aroma; Resistant to anthracnose and powdery mildew;		

13.3 FACTORS TO CONSIDER WHEN SELECTING A SITE FOR MANGO PRODUCTION

- Soil: Deep well drained sandy loam and a pH range 5.5 to 7.5
- Rainfall: Minimum of 650mm per annum and a dry period for flowering and fruiting. Rainfall during flowering reduces yield
- Altitude: below 600m although some upland varieties can produce at high altitudes 1500m.
- Temperature 24-28 ^{0}C High temperatures during flowering are ideal for fruit development.

13.4 PREPARING A SITE FOR MANGO SEEDLINGS

13.4.1 Land Preparation: Involves

- Clearing the land of any bush, trees and stumps;
- Ploughing;
- Harrowing;
- Making planting holes. The holes should be made 2 months before planting. They should be 90cm by 90cm by 90cm and they should be spaced at 9m by 9m or 10.5m by 10.5m or 12m by12m depending on the variety;

13.4.2 Applying Manure

The top soil is mixed with 10 kg of manure and fill the hole. The sub soil will be used for making the basin around the tree.

13.5 TRANSPLANTING MANGO SEEDLINGS

Seedlings are transferred from the nursery where they were raised and planted in the field

Procedure

- Water the planting hole and the seedling;
- Cut and remove the polythene bag around the roots of the seedlings. Don't destroy the roots and the ball of the soil around the roots. For bare rooted seedlings push a hand trowel into the soil 10 cm away from the seedling and turn the trowel upwards such that it removes the seedling together with the ball of soil;
- Place the seedlings together with the ball of soil around its roots in the centre of the hole;
- Fill the space around the seedling with a mixture of topsoil and manure until the ball of soil around the seedling (collar mark) is completely covered;
- Firmly press the soil around the ball of the soil to keep the seedling upright;
- Use sub soil to build a basin around the seedling to hold water;
- Mulch around the seedling. Mulch should not come in contact with the seedling to prevent termites;
- Water the seedling;

13.6 PESTS OF MANGOES

Pest	Damage	Control
Mango stone weevil	They are dark or brown in colour. The larva stage enter the fruit at an early stage and feed on the pulp and the seed(stone) They cause premature fall of fruits Discolouration of fruits	Collecting and burying all dropped and rotten fruits hence larva will not mature. Spraying Fenthion or carbaryl
Mango scales	These are small white flat oval or elongated insects. They attack leaves stems and fruits They produce honey dew (sugary substance) which is a host for sooty moulds	Spray dimethoate 20Wp at 85g in 14 litres
Fruit flies	Fries lay eggs on the fruits Shiny white maggots hatch and enter the fruit. They eat up the flesh of the fruit Part of the fresh become liquid Premature fruit fall Fruits change colour before they are ripe	Collect and bury fallen mangoes Spray Fenthion (Labcycid)50 EP at 1 ml per litre of water

13.7 DISEASES OF MANGOES

Disease	Description	Symptoms	Control
Anthracnose	It is a fungal disease. It affect leaves, stems and fruits.	Black substance on the leaves Black sports on fruits Premature ripening of fruits Rotting of fruits Fruits are bitter and sugarless	Spray appropriate fungicides e.g. Benlate 50 WP at 15g in 10 litres of water
Powdery mildew	It is a fungal disease It affect leaves, flowers and fruits	Whitish powder appear on flowers Shedding of flowers and immature fruits Young leaves become curled, distorted and stunted	Spray appropriate fungicides e.g. Benlate 50 WP at 15g in 10 litres of water

TOPIC 14: CATTLE PRODUCTION

14.1 BREEDS OF CATTLE

Cattle breeds can be classified into dairy and beef breeds. Dairy breeds are those that produce a lot of milk and beef breeds are those that produce more meat. The two main cattle breeds are local (indigenous) and exotic.

14.1.1 Breeds of cattle for beef production

(a) Local breeds

Malawi Zebu is the only example of the local breed raised in Malawi for both beef and dairy.

The table below show Exotic breeds of beef breeds

Breed	Colour	Origin
Hereford	Deep red with white face	United Kingdom
Simmental	Light red with white patches and white head	Switzerland
Brahman	White or greyish	India
Charolais	White	France
Boran	Red white, white grey or brown	Kenya
Sussex		Britain
Afrikander	Black	South Africa

14.1.2 Exotic breeds of dairy cattle

Breed	Colour	Origin	Milk yield(kg)
Friesian	Black and white	Holland	5,000
Guernsey	Fawn	England	4,300
Jersey	Brownish	England	3,500
Ayrshire	Red and white	Scotland	4,000

14.2 CHARACTERISTICS OF CATTLE FOR DAIRY AND BEEF BREEDS

14.2.1 BEEF BREEDS

- The legs are short;
- Deep, compact well fleshed bodies (with a lot of flesh);
- Rectangular or square shaped body referred to as blocky;
- They grow and mature quickly;

14.2.2 DAIRY BREEDS

- Thin (lean) body with little flesh and with visible pin bones;
- The body is wedge or triangular shaped as viewed from the sides;
- Wide and well set hind quarters;
- Large and well developed udder with well-spaced teats;
- Large abdomen;

14.3 MANAGEMENT PRACTICES FOR BEEF AND DAIRY CATTLE

Management Systems

i) Extensive System

Cattle are grazed on communal lands usually dambo. They are also grazed in ranches (large areas) e.g. Dzalanyama cattle ranch in Lilongwe and Kuti cattle ranch in Salima. They are also grazed in farms after harvesting e.g. groundnut haulms, maize stover and potato vines.

Advantage: Cheap to keep cattle on communal lands since it does not require construction of pens.

Disadvantages:

- Difficult to control stocking rate hence soil degradation;
- Difficult to control parasite and diseases;

- Animals take time to reach maturity and slaughter weight since they lose a lot of energy and weight walking from place to place looking for food;

ii) Intensive system

Animals are kept in stalls (khola) feedlots or grazed by rotating them in paddocks.

Advantages: i) Diseases and parasites are easy to control;
ii) Animals fatten quickly since movement is restricted

Disadvantage: i) Expensive to construct pens;
ii) Labour intensive in cutting and transporting feed to the khola dairy

14.4 MANAGEMENT PRACTICES

Management practices involves proper housing. Feeding, breeding and parasite and disease control.

14.4.1 Proper Housing: Housing management involves providing animals with a suitable house.

Characteristics of a suitable cattle house

- It should be well ventilated to reduce dampness, regulate temperature and avoid spreading of diseases.
- Spacious/roomy/big enough for easy cleaning.
- It should be sited on a well-drained ground to avoid dampness.
- It should be well roofed/thatched/ have a leak proof to avoid dampness which can cause diseases.
- For dairy house, it should have an extra structure for milking (a milking shed or parlour) and a calf pens.

Materials Required For Constructing a Cattle House

Cement, sand, quarry stones, poles, bamboos, grass, nails, linya, sisal strings, bricks, mud

Procedure for constructing a cattle house

- Assemble all materials required;
- Choose a good site;
- Clear the area of any bush;
- Measure the area N/B One animal needs a floor space of 2.0m by 2.0m by 2.4m high;
- Measure and stake out the right angles at the corners of the house to form a rectangular shape;
- Dig holes 0.6m deep and about 1.8 m apart and poles should be 3.0m high;
- Insert poles into the holes leaving 2.4m of the poles above the ground;
- Add a mixture of cement and sand into the hole to make the poles tightly fixed into the soil;
- Make the walls by nailing pieces of wood on the poles leaving the gate;
- Make the roof using bamboos and grass or where possible using iron sheets and make the floor using concrete. (For dairy cattle construct additional structure for milking and calf pens);

14.4.2 Proper Feeding: Feeding management involves providing a balanced ration to livestock according to the type of animal, age and their condition.

Suitable feeds for cattle

- Roughages e.g. banana stems, star grass, sweet potato vines, Leucaena, ground nut haulms hay silage.
- Energy and protein concentrates e.g. Madeya, soya meal, bone meal, cotton cake etc.

i) **Feeding calves**

A newly born calf is fed on the first milk called colostrum which is produced within the first days after calving.

Importance of colostrum

- It contains antibodies which increase immunity to help calves fight against diseases.
- It is highly nutritious rich in proteins vitamin A E and D, minerals and fats for health growth
- It is highly digested hence suitable to calves whose digestive systems are not well developed

Calves for beef cattle are weaned at 3 months old while for dairy cattle 3-4 days old there after they are fed from a bucket up to 3 months old. From 3 weeks old they should be fed on fresh grass and a lot of supplements for fast growth.

ii) Feeding heifers: Heifers should be fed them high quantity of production ration for fast growth and to enable them conceive since the feed will induce heat and assist them during pregnancy.

iii) Feeding pregnant cows: An in - calf cow (pregnant cow) should be given extra concentrates two months before giving birth. This is called steaming up.

Importance of steaming up

- To provide sufficient nutrients to the rapid growing foetus;
- To help the cows' body to develop for milk production;
- To enable the cow to be in good condition for calving;

iv) Feeding lactating cows: As soon as the animal gives birth milk yield starts increasing so the farmer must continue increasing amount of feed for high milk production. Two months after giving birth the cow is served. Two weeks before serving it the farmer must give the cow high amount of concentrates. This is known as flushing. This is done to improve the cows' fertility and enable it conceive.

Guidelines for feeding dairy cows

- For maintenance, provide 2 – 4 Kg roughages per 100Kg live weight per day;
- For milk production, provide 1 Kg concentrates for every 3 Kg of milk produced;
- Provide cows with plenty clean water at all times;

v) Feeding of fattening animals: Must be fed with concentrates to develop a lot of flesh

14.4.3 Proper Breeding

- Breeding management involves selecting good quality steers and heifers for breeding in order to produce off springs with good qualities.
- Mating off the animals at the right time (right age and proper body weight). Heavy breeds should be mated at 280 -320 Kg. Light breeds at 250- 270 kg. Malawi Zebu at 250kg.
- Keeping the recommended breeding ratio is 1 bull to 20 or 30heifers.
- Mating of animals should be properly timed so that calving takes place when pasture is plenty.

14.4.3 Management practices done when rearing calves

i) Dehorning : This is the removal of the horns from cattle using a hot iron or a saw. It is done when the calves are 2 weeks old.

ii) Castration: This refers to the removal of testes to prevent animals with undesirable qualities from mating. It is done when the calves are 3months old.

iii) Disbudding: This refers to stopping the growth of the horn buds using a dehorning iron.
Importance: To prevent the animal from hurting the farmer when handling it or from hurting other animals.

iv) Branding: This means placing an identification mark or number on the animal. A cold (frozen) or a hot iron is used on the skin of the animal.
Importance: For easy identification.

v) Vaccination: This is done to induce immunity so that the calf body can fight against diseases.

vi. Drenching: This refers to the giving animals drugs through the mouth.
Importance: To control internal parasite.

14.4.4. PROPER PARASITE AND DISEASE CONTROL

Involves diagnosing the disease and parasite attack properly and providing proper control measures.

Cattle Diseases -

i) East Coast Fever: It is caused by protozoa and transmitted by a brown ear tick. It has no treatment.

Signs	Control
i) High temperature; ii) Diarrhoea; iii) Loss of appetite iv) Swollen lymph nodes; v)Small haemorrhages in vulva and oral mucous membranes	Tick control Restrict movement of cattle

ii) Red water: It is cause by a protozoa and transmitted by a blue tick, brown tick and a red tick

Sign	Control
i)High temperature; ii) Red urine iii) Anaemia	i) Control ticks; ii) Vaccinate animals; iii) Control movement of animals; iv) Giving them appropriate drugs

iii) Heart water: It is caused by bacteria and transmitted by ticks

Signs	Control
i) High temperature; ii) Convulsion or fits; iii) Death	i) Treat with antibiotics; ii) Control ticks iii) Vaccinate

iv) Gall sickness (Anaplasmosis)
It is caused by bacteria and transmitted by a blue tick.

Signs	Control
i) High temperature; ii) Loss of appetite iii) Pale mucous membranes; iv) Yellow urine	i) Treat with antibiotics e.g. tetracycline ii) Control ticks

v) Foot and mouth: It is caused by virus. It is highly contagious and infectious. It is a notifiable disease. It is transmitted through contact. It has no treatment.

Signs	Control
i) High fever; ii) Painful blisters on the tongue, mouth and between the hooves iii) Lameness; iv) Difficulty in eating v) Excessive salivation	i) Vaccination; ii) Quarantine iii) Slaughter all infected animals and bury or burn them.

vi) Rinder pest (Cattle Plague)
It is caused by virus. It is highly contagious and infectious. It is a notifiable disease. It is transmitted through contact. It has no treatment.

Sign	Control
i) Diarrhoea; ii) High fever; iii) Sores in the mouth and nostrils; iv) Fast breathing	Quarantine the animals Slaughter and bury or burn infected animals

vii) Mastitis
It is caused by bacteria. Predisposing factors are: Poor milking hygiene and techniques which results in injuring the udder due to bruising, incomplete milking (when milk is left in the udder it acts as a culture medium for bacteria.

Signs	Control
i) High fever; ii) Swollen or inflamed udder or teats; iii) Blood clots or pus in milk	i) Treat with antibiotics like tetracycline; ii) Practice hygiene during milking

viii) Tuberculosis

It is caused by bacteria. It can affect lungs, digestive, urinary, reproductive and nervous systems.it is spread by contact with in exhaled air, urine and faeces.

Signs	Control
i) Persistent coughing; ii) Body temperature fluctuates; iii) Animal loses weight; iv; Thick white vaginal discharge; v) Animal may become sterile vi) A soft chronic cough occurs once or twice at a time; vii) Diarrhoea; viii) Swollen lymph nodes	Slaughter infected animals and bury/burn them Vaccination using B.C.G vaccine

ix) Anthrax: It is caused by bacteria and spread through ingestion or inhalation of bacteria. It has no treatment.

Signs	Control
High fever and high body temperature Blood discharge from the nose and mouth Post mortem may show an enlarged spleen that looks black in colour	Vaccination Bury dead animals

x) Brucellosis (Contagious abortion): It is caused by bacteria and spread through contact. It has no treatment.

Sign	Control
i) Abortion; ii) Swollen testicles in young bulls; iii) Brown vaginal discharge; iv) Inflamed genital organs of a cow	Kill all infected animals Vaccination.

xi) Black quarter: It is caused by bacteria. Infection occurs after shearing, docking castration, if wounds are inflicted on the animal.

Signs	Control
i) High fever; ii) Loss of appetite; iii) Lameness iv) Black stained exudate from the anus and nose; v) Black meat in the hind legs if examined after death; vi) One of the legs become swollen and stiff; v) Gas filled swellings or heavy muscles of neck and legs;	Treat with antibiotics Restrict movement of animals Bury or burn dead animals Vaccinate with Blanthrax vaccine

xii) Calf Scours (Calf enteritis): It is caused by bacteria. It is an acute disease of calves up to 3 months.

Sign	Control
i) Diarrhoea; ii) High temperature; iii) General body weakness; iv) Death	Isolate sick animals

xiii) Trypanosomiasis (Nagana): It is caused by bacteria and spread through tsetse flies.

Signs	Control
High temperature General body weakness Anaemia Inflammation of cornea which may lead to blindness	Control tsetse flies Treat infected animals with suitable drugs like berenil Confinement of game animals in nation parks as these act as alternative host for the disease vector

Xiv) Lumpy skin disease. This is an acute infectious disease caused by virus and is transmitted by flies

Signs	Control
i) Fever; ii) Skin nodules or skin lumps covering the whole body iii) Emaciation; iv) Milk production stops	i) Vaccination; ii) Quarantine iii) Control vectors

xv) **Milk fever**: This disease affect dairy cattle three days after calving. It is caused by low levels of calcium in the blood stream (a condition known as hypocalcaemia)

Signs	Control

i) General weakness; ii) Drop in temperature; iii) Muscular twitching causing the animal to tremble; iv) In ability to stand and the animal lies down on its side most of the time. v) General paralysis such that the body functions such as urination, defecation and secretion stops followed by death.	Feed animal with a diet rich in calcium especially during pregnancy and early lactation; Give intramuscular injection of calcium 2-3 days before calving; Cull susceptible animals; Pump air into the udder to limit milk production;

xvi) Bloat

It is a condition in which gases accumulate in the rumen due to rapid fermentation of the feed eaten by the animal. It is caused by feeding animals large amounts of legume; abrupt change in feeds given to animals leading to indigestion; Blockage of the oesophagus by large food particles;

Sign	Control
Distension of the left side of the abdomen due to gas accumulation; Difficulty in breathing; Kicking of the berry; Profuse salivation;	Provide dry roughages just before feeding animals on green and succulent or wet pasture; Feeding animals on wilted grasses and pasture legumes; Provide them with liquid paraffin mixed with vegetable oil; Feed animal with salt since it has a laxative effect; Insert a pump into the stomach through oesophagus to remove gas;

Cattle parasites

Classification of parasites

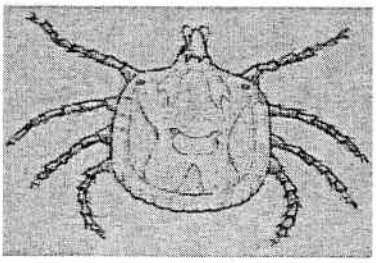
i) **External parasites (Ecto parasites)**. These are parasites that feed on outside the body of the animal e,g Tsetse flies, lice tics and mites.

ii) **Internal parasites (Endo parasites)**. These are parasites that live inside the body of the host e.g. liver flukes, tape worms and round worms.

External Parasites (Ecto Parasites)

a) Ticks

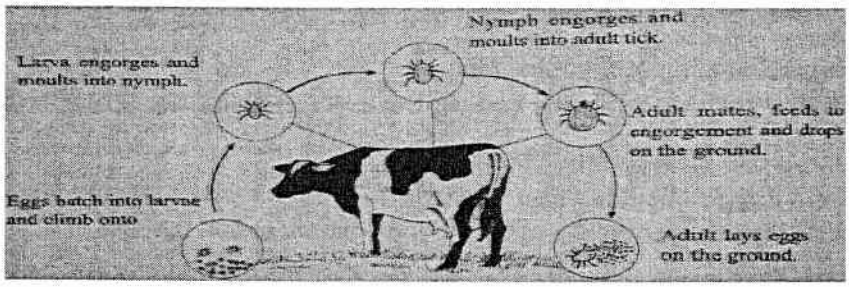
ii) A two host tick:

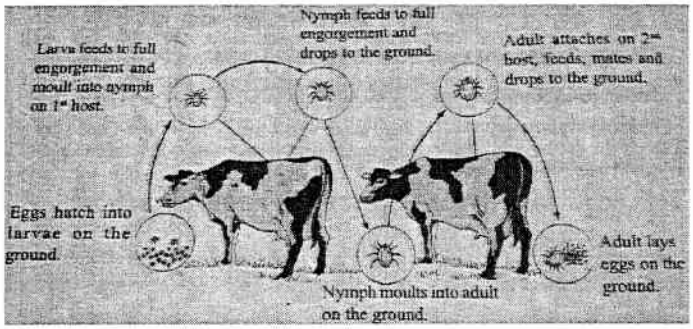


Life Cycle of a tick

i) **One host tick:** These ticks need only one host to complete all stages in the life cycle e.g. a blue tick.

The life cycle of a one host tick.

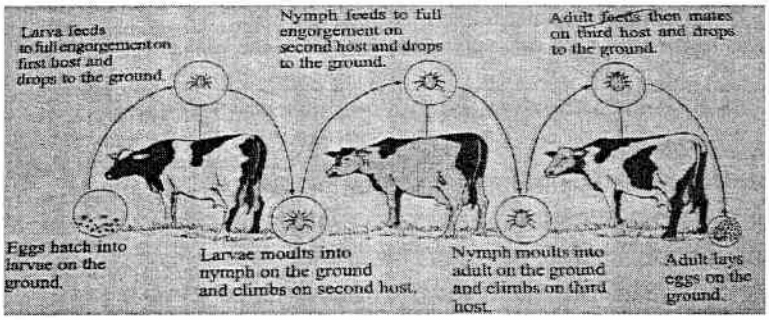




The life cycle of a two host tick

These ticks need two hosts to complete their life cycle. Their first moulting stage from larva to nymph takes place on one host but the second moulting stage from nymph to adult takes place on the ground.

iii) **A three host tick**

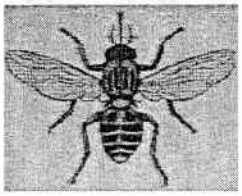


The life cycle of a three host tick

These ticks need three hosts to complete their life cycle e.g. a hard tick. They undergo both moulting stages on the ground.

Effects of ticks on livestock	Control of ticks
Transmit diseases hence causing death; Suck blood causing anaemia; Damage the skin through biting;	Rotational grazing to break their life cycle; Burn off infected pasture to destroy life stages on the ground; Deep ploughing to bury ticks and their eggs; Dipping or spraying using tick killing chemicals;

b) **Tsetse flies**



<u>Effects of tsetse flies on livestock</u>

They suck blood causing anaemia;

They transmit trypanosomiasis (Nagana) disease;

<u>Control of tsetse flies</u>

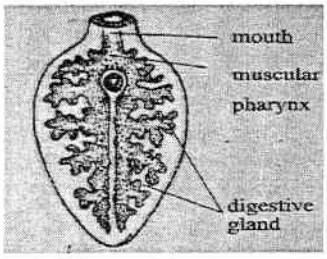
- Clear the bush infested with tsetse flies;
- Spraying the infected bush;
- Trapping tsetse flies with nets treated with chemicals;

Internal Parasites (Endo Parasites)

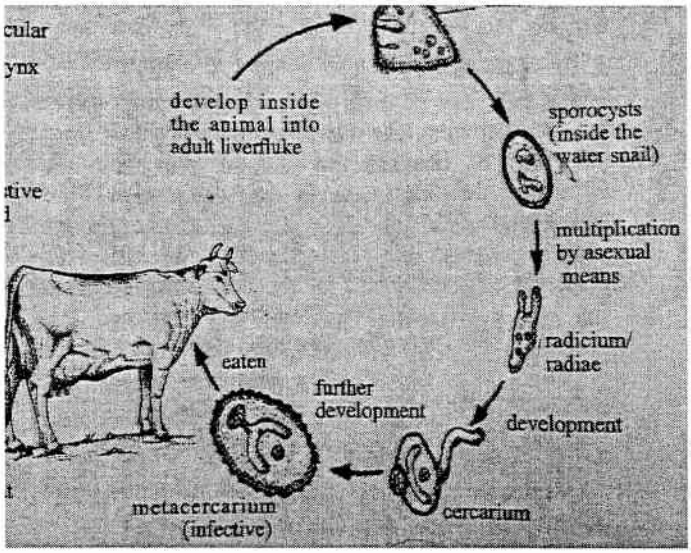
Parasites that live inside the body of the host examples liver flukes, tape worms and round worms.

i) **Liver fluke (Fasciola hepatica)**

This is a flat worm. It is shaped like a leaf. The adult worm inhabits the live where they develop 5 -6 weeks then they enter the bile duct and become sexual mature.



Liver fluke

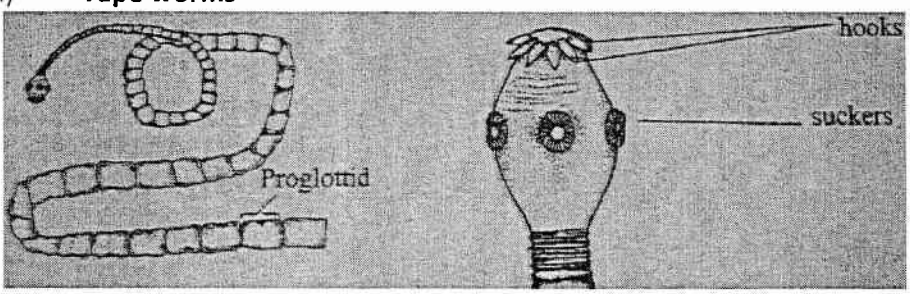


The life cycle of a liver fluke

- The egg are passed out in faeces;
- The eggs hatch into the first larva stage called miracidium;
- Miracidium swim in water by means of cilia and penetrate the water snail which is the intermediate host;
- Miracidium develops into sporocysts inside the water snail;
- Sporocysts reproduce asexually and multiply into radiae;
- Radiae develops into cercarium;
- Cercarium develops into metacercarium which is the encysted infective stage;
- Metacercarium leaves the water snail and attaches themselves onto the grass;
- They enter the primary host (animal) when eaten during grazing;
- Metaecercarium (infective stage) hatch into adult inside the animal. They penetrate the intestinal walls and inhabits the liver, then they enter the bile duct and become sexually mature;

Damage caused by liver fluke	Signs of attack	Control
Damage the liver; Digestive upset due to blocking of the bile duct;	Swollen abdomen; Anaemia as the result of damaged liver; Oedema in the jaws; Emaciation leading to death;	Routine drenching with anthelminthic drugs; Destroying water snail by treating swampy areas with copper sulphate; Draining swampy areas to prevent water snails; Fencing off infected areas to prevent grazing in such areas;

ii) **Tape worms**



A tape worm consist of a head and a chain of segments. Each segment is called a ploglottid.

The life cycle of a tapeworm

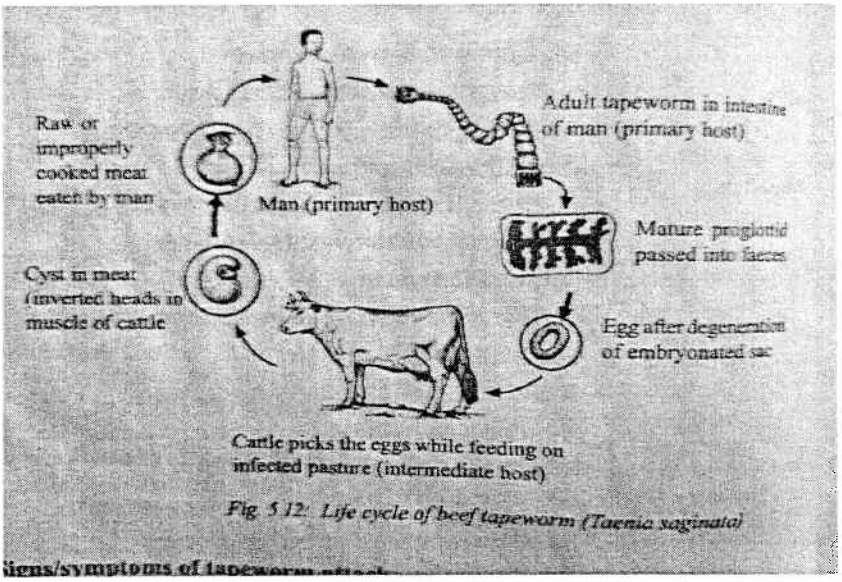


Fig 5.12: Life cycle of beef tapeworm (Taenia saginata)

Signs/symptoms of tapeworm attack

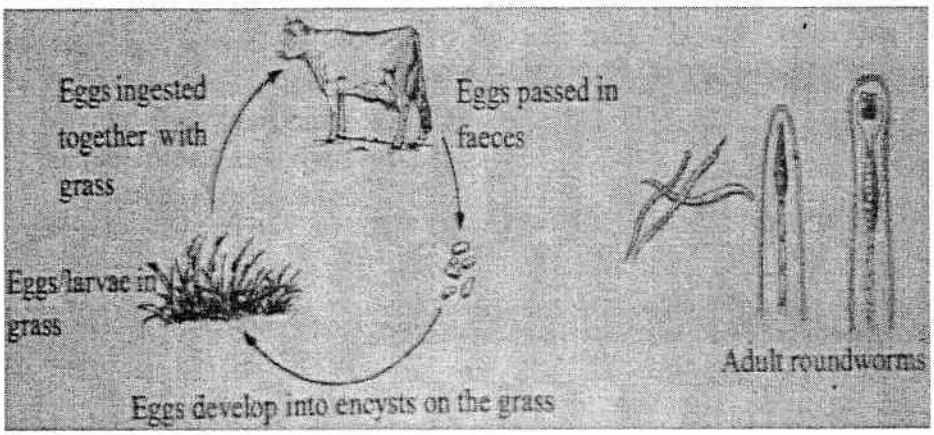
It starts with passing out of eggs in faeces by the primary host (man).The eggs are passed out while intact in ploglottids (sac)
The ploglottids burst and releases eggs which are eaten by the intermediate host (animal) when grazing.
The egg embryo develops into a bladder worm which hides within the muscle tissue of the animal
When its meat is consumed by man raw or undercooked the bladder worm become active and they attach themselves to the intestinal walls, and develop into adult tapeworm.

Damage caused by tape worms	Sign of attach	Control
Feed on digested feed Larva gets into the lymphatic vessels disturbing translocation of food.	Diarrhoea Pot belly Anaemia Rough hair coat Oedema Egg segments in the faeces	• Deep ploughing in order to bury eggs • Proper disposal of human waste • Proper cooking of meat • Drenching / deworming the animal with suitable drugs like albendazole, mebendazole.

iii) Round worms

These are cylindrical in shape. They inhabit alimentary canal of livestock and feed on digestive feed.

<u>The life cycle of round worms</u>

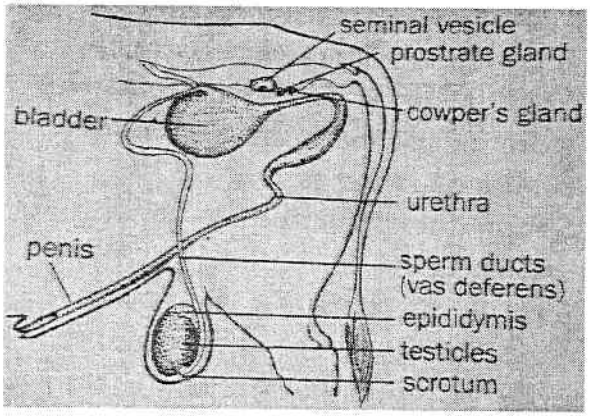


The eggs are passed out in faeces. They hatch into larva. The larva penetrates the skin of the host and develops into adult within the host to maturity.

Damage caused	Signs	Control
Absorbs digested feed	• Retarded growth since the digested feed is used by the worms; • Anaemia due to damaged intestinal walls causing loss of blood; • Pot belly;	• Deep ploughing to bury eggs • Deworming using thenothiazine • Avoid grazing animals on muddy grounds

TOPIC 15: REPRODUCTIVE SYSTEM OF POULTRY AND CATTLE

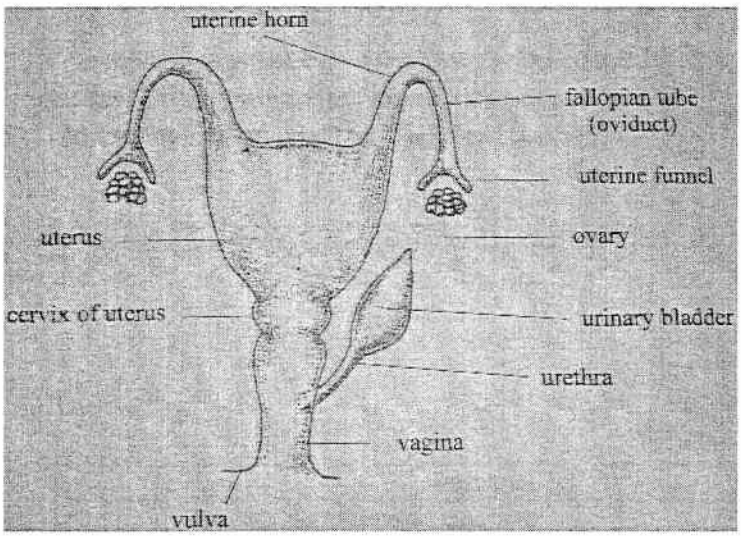
15.1 Reproductive System of a Bull



These are organs that are directly involved in producing storing and delivering sperms into the reproductive system of a cow for pregnancy to occur.

Part	Description	Function
Testicles (testes)	Male sex organs These are two oval shaped; Located outside the body and suspended between the hind legs.	Produce sperms(male gametes) Secrete male sex hormone called testosterone
Scrotum	It is a sac with loose skin and muscle that holds the testicles	It supports and protects the testicles It regulates temperature for sperm development
Epididymis	It is a long, narrow coiled tube. It surrounds each of the testicles.	It stores sperms It carries sperms to the sperm duct
Sperm ducts	Also known as vasa deferentia. One sperm duct (Vas deferens). These are long tubes an extension of epididymis	They carry sperms from epididymis to the urethra.
Urethra	It is a tube that leads from the bladder through the penis	It is the passage for semen from epididymis through the penis during mating and urine from the bladder through the penis to the outside
Penis	It is a muscular and tubular structure surrounded by a protective sheath; It located outside the body of a bull; It has spongy tissues that gets filled with blood as the bull mates to facilitates easy entry into the vagina; It has a sigmoid flexure (S- shaped bend which enables the penis to retract after copulation; It has a retractor muscle to help in pulling the erect and exposed penis back into the sheath;	used for copulation / mating used for depositing sperms into the vagina
Accessory glands	It is found where urinary and reproductive system meets. They include: i. Cowper's gland ii. Prostate gland iii. Seminal Vesicles	Cowper's gland produce a fluid that help to neutralise urine in the urethra; They produce a saline glucose rich fluid that activates the sperms; They produce a sticky fluid which carries the sperms. The resultant fluid is called semen;

15.2 The Reproductive System of a Cow

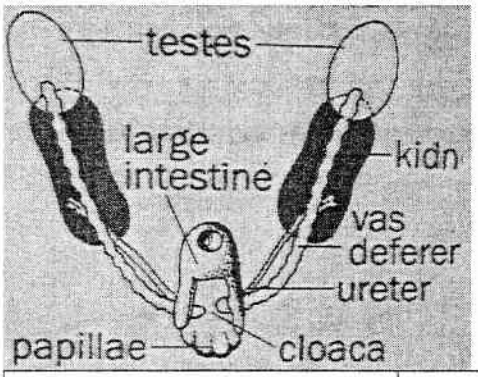


The reproductive organs of a cow are those that are directly involved in the production of ova, in the pregnancy of the cow, and in delivering of a calf.

Part	Description	Function
Ovaries	These are two small oval shaped organs They are situated in the abdominal cavity close to the kidneys They contain thousands of follicles(sacs) each containing egg cell	They produce female gametes called ova They produce hormones which control sexual circle and course of pregnancy
Oviducts Also called fallopian tubes	These are a pair of thick walled tubes The opening of the oviduct are funnel shaped	They receive the ova and directs it to the uterus; It is a site of fertilisation,
Uterus(Womb)	It is a hollow organ with two horns connecting to the oviduct It has a muscular wall which help in pushing the calf during birth	It is the site where the zygote into a young animal; It provides nutrients to the foetus;
Cervix	It has thick muscles; It connects uterus and the vagina; It is always closed except during heat and parturition	It protects the uterus from foreign material and infection entering from the vagina
Vagina	It is a muscular canal or tube; It is located between the vulva and the cervix	Used for copulation where semen is deposited It serves as a birth canal
Vulva	It is an external opening of the female reproductive system	It receives the penis into the vagina during copulation; It conducts urine outside; It acts as a passage for the calf during birth;

15.3 THE REPRODUCTIVE SYSTEM IN POULTRY

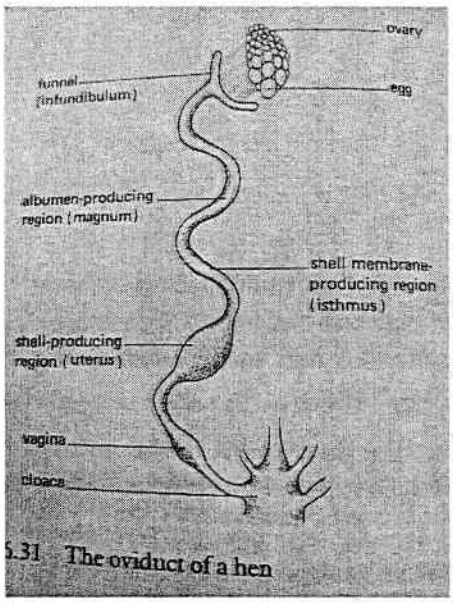
The productive system of a cock



It consists of testes, vas deferens, papillae and cloaca.

Part	Description	Function
Testes (testicles)	A cock has a pair of testicles They are situated in the abdominal cavity near the kidney	Produce sperms
Epididymis	A coiled tube that surrounds testes	Store sperms
Vas deferens (sperm ducts)	These are tubes. The terminal end of the vas deferens ends near certain structures on the dorsal wall of cloaca. The structures are called papillae.	Leads sperms to the cloaca
Papillae	This is a terminal end of the vas deferens.	Serve as a copulatory organ that deposit sperms into the cloaca

The productive system of a hen



5.31 The oviduct of a hen

It consists of only one functional ovary and oviduct. It is situated on the left hand side of the hen. The right side ovary is not well developed. The oviduct is a long tube 65 cm long. It consists of different sections (Infundibulum, magnum, Isthmus, uterus, vagina and cloaca.) It is suspended by muscular bundles and connective tissues. It takes about 24 – 26 from ovulation to the time the egg is oviposit

Part	Description	Function
Ovary	It is located near the kidney	Production of ova
Infundibulum (Funnel)	It has thin a wall and has cilia	It receives and stores sperms It is the site of fertilisation

	It is 10cm long The egg takes 15 minutes in this section	It receives egg from the ovary It forms chalaza(a membrane of twisted string that suspends the yolk in position)
Magnum	It is about 37 cm long The egg takes about 3 hours to pass through this section	It is the site for albumen (egg white) production and addition to the egg. (The egg white protects the embryo and also used as food.
Isthmus	It is 12 cm long The egg takes about 1 hour 15 minutes in it	It is the site for production and addition of membranes to the egg. Water, Vitamins and mineral salts are also added to the egg
Uterus (shell gland)	It is 8 cm long The egg takes about 18 – 21 hours in it	This is the site where egg shell is added on the egg though deposition of a lot of calcium. Function of the shell i) It protects the egg; ii) It gives the egg its shape; iii) Allows gaseous exchange; iii) Shell pigments and egg colour are produced and incorporated on the shell;
Vagina	It is about 7 cm long The egg stays in vagina for 10 minutes	i) It forms a muscular exit which helps expulsion of the egg through cloaca. The process of egg laying is called oviposition. ii) Sealing of pores in the egg
Cloaca (vent)	It is a copulatory organ.	Used for mating where sperms are deposited Allows egg to be oviposited

15.4 PUBERTY IN CATTLE

Puberty is the stage of sexual maturity when physiological changes related to reproduction begins. It is controlled by hormones. In bulls testosterone hormone controls maturation of sperms and accessory glands and desire to mate. In cow, oestrogen activates egg development, ovulation and development of uterus and heat period. Cattle reach puberty at 9-18 months old.

Factors that affect age at puberty

- Breed of the animal. Exotic breeds reach puberty earlier than local breed and cross breeds reach puberty earlier than pure breeds due to heterosis (increase in hybrid vigour).
- Nutrition: Animals that are well fed reach puberty earlier since they get adequate nutrients.
- Exposure to opposite sex: Heifers that are kept together with bulls reach puberty earlier.
- Animal type dairy cattle reach puberty earlier than beef cattle.

15.4 OESTRUS CYCLE OF A COW

Oestrus cycle refers to the changes that occur in female animals from one heat period to another. It is controlled by hormones.

Phases of oestrus cycle

1. Proestrus: This phase can last up to 3 days. Pituitary gland secretes a Follicle stimulating hormone (F.S.H) which cause the follicles around the egg to develop. The developing follicles secretes oestrogen hormone which induces heat period. Oestrogen causes development of ovary and walls of uterus, the vaginal walls thicken and is lubricated, vulva swells, cervix open ready for mating.

2. Oestrus: When the dominant follicle matures, Pituitary gland secretes Luteinizing hormone (L.H) which causes the follicles to rupture releasing the egg. The process is called ovulation. The cow has a strong sexual desire.

3. Metoestrus : The oestrus ends. The ruptured follicles quickly develops into corpus luteum (Yellow body). Corpus luteum becomes a gland that secrets progesterone hormone.
Progesterone hormone maintains pregnancy, causes heat to stop, closes the cervix, causes development of uterine walls and mammary glands and inhibits ova development.
A phenomenon called metoestrus bleeding can be seen in the vagina.

4. Dioestrus: This is the period of maximum corpus luteum size and function. Corpus Luteum is retained if fertilisation takes place and the animal is pregnant. Corpus Luteum continues to produce progesterone until foetus is mature. Corpus Luteum stop its function and oestrogen is active again relaxing the cervix, lubricating the vagina, contracting the uterus and helping the birth process.

15.4.1 Oestrus cycle in different animals

Ewe: 21 days Sow 17 days
Cow: 21 days nanny 21 days

The knowledge of oestrus cycle is important because it assist the farmer to carry out successful breeding programme since he knows when the animal will be on heat.

15.4.2 Heat

This is the period when the animal show signs of willingness to accept the male. (Desire to mate)
Heat and ovulation tend to fall at around the same time.
It is important for the farmer to know the signs of heat so that he can arrange for the cow to be served at the right time for successful fertilization.

15.4.3 Signs of heat

i) Clear mucus discharge from the vulva; ii) A moist red and swollen vulva; iii) Frequent urination; iv) Frequent mooing (bellows); v) Restlessness(Excessive walking in search of a bulls); v) It mounts other cows and stand still when mounted by other cows (this is known as standing heat it extend for 12- 18 hours); Vi) Loss of appetite; vii) Drop in milk production; viii) Rise in body temperature

15.4.4 Chart for mating animals

Standing heat first observed	When to breed
In the morning	In the evening of the same day
In the evening	Next morning

15.5 GESTATION PERIOD

This is the period from conception to the birth of a young animal (Parturition)

Type of animal	Cow	Ewe	Nanny	Sow
Length of gestation (days)	270-280	150	150	115 (3 months 3 weeks 3 days)

Why should the farmer know gestation period of farm animals?

- In order to plan steaming up.
- For close supervision of the animal towards labour time in case there will be complications.

15.6 PROCESSES OF REPRODUCTION IN CATTLE

15.6.1 Mating

i) **Natural mating:** A type of mating whereby a bull directly mounts a female on heat and introduces semen into its reproductive tract.

ii) Artificial insemination

The act of depositing semen into the reproductive tract of the female animal using an instrument.

15.6.2 Fertilisation

This is the fusion of male and female gametes to one single cell of the individual called a zygote. Fertilisation takes place in the upper one third of the oviduct. Correct timing of insemination in relation to ovulation is very important since ova remains viable for only 5-6 hours. Mating should therefore should take place 7 – 10 hours after the onset of heat (middle of heat period). Fertilised egg undergoes several cell division to form a hollow mass of cells as it moves down the oviduct to the uterus.

15.6.3 Embryo development

The zygote develops finger like projections called villi used for attaching itself to the walls of uterus and the process is called implantation. Upon implantation it becomes an embryo.

The villi together with the walls of uterus develops into a placenta. The embryo is attached to the placenta via umbilical cord.

Cell division continues to form organs and tissues e.g. the gut, muscles, bones, heart, circulatory System, blood and connective tissues, skin and the nervous system.

The embryo become enclosed in a membrane called amnion which encloses amniotic fluid. The amnion is surrounded by chorion membrane. Allantois membrane develops as the urinary bladder becomes developed and is filled with urine from the foetus.

Function of the membranes

- To keep the foetus warm;
- To serve as lubricants during parturition;
- Act as a cushion to protect the foetus from external shock;

15.6.4 Foetus development

When the embryo has fully differentiated organs and tissues (body parts) it becomes foetus and this is about 3 months of pregnancy. Foetal growth is very rapid in the last stage of pregnancy

Feeding of foetus: Dissolved food nutrients from the mother blood diffuse into the placenta capillaries by the way of villi them from the placenta via the umbilical cord to the foetus.

Respiration of foetus: Oxygen from the mother's blood diffuse through the placenta to the blood of the foetus, oxygen is used to oxidise food nutrients as a result carbon dioxide, water and energy in the form of heat are produced. Energy is used for metabolic activities off the body.

Excretion

Waste products (carbon dioxide, nitrogenous waste) diffuse from the foetus blood back into the mother blood across the placenta.

Caring for pregnant cows

(a) Steaming up. (Read "Cattle production on feeding pregnant cows")
(b) The in calf cow should be placed in a calving pen few weeks before giving birth. For close supervision.

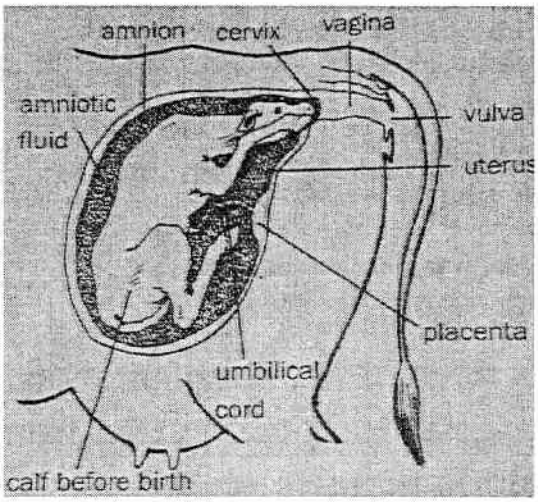
15.6.5 Parturition

The process of giving birth to a calf. It is also called 'calving' in cattle. Preparatory stage is called labour.

Signs of parturition

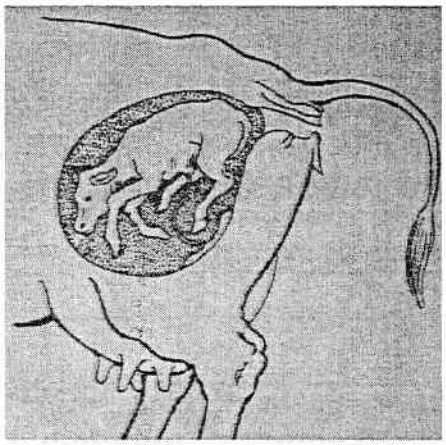
- Restless;
- Mucus discharge from the vulva;
- The vulva become swollen, large and red;
- The cow isolates itself from the rest of the herd and looks for a quiet place;
- Enlargement of the udder and production of the first milk;
- The amniotic sac breaks releasing the fluid;

Normal presentation



The front feet first with the head resting on between the legs. This is the normal way of giving birth.

Dystocia: A term that is used when the animal is having difficulties (complications) when giving birth.



Breech presentation

Types of complications

- Breech (bad positioning of the foetus) e.g rear end first, fore legs folded, head twisted backwards, foetus lying on its back in the uterus.
- Oversize foetus hence not come out in a normal way.
- Size of the cow: a cow with small body weight and small pelvic area.
- Inability of the uterus to contract enough to expel the foetus.
- Failure by the cow to push the calf due to weakness.
- Reduction in size of the birth canal due to too much fat accumulation around the pelvic area.

Sign of complications

- A long delay in the appearance of the calf once the bag breaks;
- If calving is taking over 3 hours after some parts of the calf appear;
- Breech presentation. If the calf is coming out abnormally;
- If cow is in distress such as there is no sign of water bag after many hours of straining;

Control of dystocia

All cows with narrow pelvic area should be culled;
Cull all cows that had problems in calving;
Provide balanced rations to cows during pregnancy to prevent them from getting too fat or too thin;
Close monitor cows during calving so as to provide help if necessary (i.e if a cow fails to deliver wash hands thoroughly, put on gloves and pull the calf down towards the udder);
For breech presentation: re- positioning the calf by turning it around completely within the womb;

15.6.6 Management of cows after calving

- Ensure the nostrils, mouth and body are clean of mucous (use clean rag to wipe the calf);
- Tie cut and disinfect the umbilical cord;
- Weigh and record the birth weight;
- Ensure that the calf suckles colostrum;
- Provide the cow with a lot of clean water;

TOPIC 16: LIVESTOCK IMPROVEMENT

Livestock improvement is the science of changing the genetic make-up of livestock and the environment in which they are kept in order to increase productivity.

16.1 AIMS OF LIVESTOCK IMPROVEMENT

To breed livestock that are resistant to adverse environmental conditions;
To breed livestock with high growth rate so that they can reach slaughter weight fast;
To breed livestock that are resistant to diseases and parasites;
To breed livestock with high productive potential in order to obtain more animal products;
To obtain high quality livestock products (quality wool, hard egg shell, high fat content);

16.2 METHODS OF LIVESTOCK IMPROVEMENT

16.2.1 INTRODUCTION

This is the process of importing exotic breeds with superior qualities than local breeds from another country e.g. Friesian, Jersey, were introduced to Malawi from Europe and America respectively. Importation can be live male animal or importing semen or embryo.

Advantage: Superior breeds are made available quickly.

Disadvantage:
The imported breeds require high level of management in order to survive in the new environment.

16.2.2 SELECTION

This is the practice of choosing livestock with desirable qualities to be parents (breeding stock) for the next generation.
The livestock selected are carriers of desirable genes which will be passed on to the offspring.

Types of selection

(a) **Natural selection**
This is the selection for breeding livestock that are better favoured by the environment than others. The breeder takes no part in this type of selection. The introduced breeds undergo this type of selection. Some breeds are likely to perform very poorly and die due to unfavourable environment. Breeds that are able to cope with the environment are selected for breeding.
(b) **Artificial selection**
This is the type of selection done by farmers in choosing livestock with desirable qualities.
The animal chosen to be parents are those whose performance are closest to the breeding objective e.g. in dairy cattle the parents chosen should be animals that producing high milk yields.

Methods used in artificial selection
i. **Progeny testing:** This involves choosing a male animal based on the performance of their offspring.

ii. **Sib selection:** This is the selection of the female animal based on its production records.

iii. **Individual or mass selection**
This choosing of livestock based on the phenotypical characteristics (observable characteristics) colour, shape of the body, body weight.

Advantage of selection: Increases frequency of desirable genes and decreases frequency of undesirable genes.
Disadvantage: Does not add any new desirable genes into the herd

16.2.3 BREEDING

It is a process of mating selected animals for the purpose of producing offspring with desirable traits
Mating

(a) **Natural mating:** This is where a male livestock is directly used to serve the female.

Advantages: i) Conception rate is higher

ii) The male detect the female on heat and serve it at the right time hence saves farmer's time in observing signs of heat.

iii) It does not require skilled personnel a trained personnel to administer it

Disadvantages

- It can easily spread sexually transmitted diseases;
- It is difficult to keep records;
- A male animal can only serve a limited stock;
- Large and heavy bulls can injure young heifers;
- A farmer can incur extra expenses to transport and keep a bull;
- There are high risks of getting undesirable traits due to in breeding;

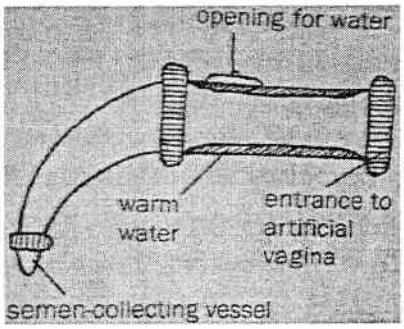
(b) Artificial Insemination (A.I)

This is the act of depositing sperms into the female reproductive tract by use of an instrument for the purpose of serving the animal. The best time to inseminate the cow is 12 – 18 hours after the first sign of heat (Middle of the heat period)

Process

(a) **Collecting semen**

Semen is collected from a proven bull using artificial vagina as it tries to mount the cow. The collector directs the penis into the artificial vagina. The semen is diluted with a diluent which consist of egg yolk, milk and glucose. The semen is stored in liquid nitrogen which is under very low temperature



(b) **Insemination**

By using recto – vaginal technique. The inseminator puts a hand through the anus to feel the cervix from within the rectal wall. Insert the syringe through the vagina and deposit the sperms in the cervix.

Advantages of artificial insemination

- It eliminates the cost of keeping a bull;
- Semen from one male can be used to service many cows than a bull would serve.
- Semen from high quality bulls can be stored and used even after the death of the bull to ensure that its traits can continue;
- Semen from heavy bulls can be used to service small cows and heifers;
- It is easy to keep records;
- Valuable bulls that cannot serve naturally because of physical handicap such as old age, size or lameness may still be made use of;
- It helps in controlling in-breeding of livestock;
- It is easy to plan breeding programme;

Disadvantages of artificial insemination

- It requires a trained personnel and special equipment and these may not be available in time;
- Due to logistical problems(transport and communication) the cow may not be served in time;
- Collection, storing and administering semen is labour intensive and time consuming;
- Does not achieve 100% results;

16.2.4 LIVESTOCK BREEDING SYSTEMS

1. **Inbreeding**

Inbreeding involves mating of closely related animals. For example son and mother, father and daughter, brother and sister.

Advantages
It promotes uniformity in a population of animals since the same type of genes are transferred to offspring. A pure breed is developed by repeated inbreeding;
It exposes undesirable recessive genes within the herd so that such animals can be culled;

Disadvantages
There is reduced performance in the animals (inbreeding depression) by concentrating too many recessive gene pairs. (Leading to weak animals, low fertility, reduced vitality);

2. **Out- breeding:** This is the mating of animals of the same breed but not closely related
For example:
Mating an Ayrshire cow raised on one farm with an Ayrshire bull from a distant farm.
Mating of second cousins. N/B The offspring of such a mating is known as an outcross.

Advantages
It results in genetic improvement which enhances vigour because of introduction of new genes in the herd. The offspring will perform better than either of the parents;
It brings desirable traits into the herd by overshadowing undesirable traits that are already present;
Disadvantages

- It is expensive to import semen or bulls from other farmers;
- It is affected by untimely importation of semen or bulls;

3. **Cross breeding:** This is mating of animals of different pure breeds. For example, Hereford bull and Zebu Cow. Friesian Bull and an Ayrshire cow.

Advantages
The crossbred offspring exhibit hybrid vigour (heterosis). Heterosis is the superiority of the cross bred offspring. They are more vigorous and grow faster, more fertile than the pure breeds.
It helps in pooling of several important genes found separately in two different breeds.

Disadvantages: It is not possible for a farmer to know at what stage of cross each animal is.

16.2.5 CHARACTERISTICS OF LIVESTOCK TO BE SELECTED FOR BREEDING

- Fast growth rate so that they can reach mature weight fast hence saving cost of feed.
- Body conformation. Choose animals of right shape for example dairy cow should have large and well-developed udders and wedge-shaped body, while a beef animal should have a rectangular body shape and well fleshed. Animals with physical defects such as lame should not be chosen.
- Mild temperament: Animals with mild temperament (docile) since they are easy to handle.
- Good reproductive traits e.g. animals with good mothering ability so that they can protect their young ones from danger. High fertility rate i.e. animals that can breed regularly and with short calving interval in order to produce more offspring.
- High productivity: It depends on the purpose for which the animal is kept. i.e. dairy (high milk yield & butter fat content) sheep (high quality wool) In layers (large egg, high rate of laying).
- High survival rate/ low mortality rate to increase livestock numbers fast.
- Good health: Choose animals with a good health record to avoid death of animals.
- Adaptation to the environment: Select animals that can adapt to the harsh environment e.g. drought and maintain their weight.

THE END