

FORM 3 AGRICULTURE

TOPIC 1: PHYSICAL PROPERTIES OF SOIL

I, **SOIL TEXTURE:** This refers to the coarseness or fineness of soil particles. Soil texture can be classified by finding out the weight percentages using the amount of dry soil then using a **soil triangle**.

THE EFFECTS OF SOIL TEXTURE ON CROP PRODUCTION

The type of soil determines the type of crop to be grown in a particular area. For instance, loam soil is good for crop production because:

- It retains water for plant growth.
- It is well - drained and aerated.
- It is able to supply nutrients to growing plants.
- Plant roots and shoots are able to penetrate and grow with ease.
- It is easy to cultivate at different moisture contents (consistencies).
- It supports micro - organisms responsible for decomposition of organic matter.
- The soil is not easily eroded and this helps nutrients to be retained.

SOIL STRUCTURE:

This refers to the way different soil particles are arranged or packed together to form aggregates. Soil structure is important because:

- It influences the movement of water and air in the soil.
- It determines the pore spaces and drainage in the soil.

TYPES OF SOIL STRUCTURE

- Flat or plate - like structure:** This is where particles are horizontally arranged on a plane.
- Prism - shaped:** Particles are horizontally arranged,
- Blocky or many - sided:** Particles are arranged in blocks
- Spheroidal:** Particles are arranged around a central point and may be crumb in shape,

EFFECTS OF SOIL STRUCTURE ON CROP PRODUCTION

- Large pores promote air flow which supplies oxygen which is necessary for root growth and activities of micro - organisms in the soil.
- Small pores retain water which is used by plants
- Seed germination and growth do not do well in soils with small pores e.g. clay due to poor aeration.

MAINTAINING AND IMPROVING SOIL STRUCTURE

- Cultivating at the right moisture content (**consistency**).
- Protecting the soil from rain drop impact by planting vegetative cover and planting close - growing crops.
- Using machinery well as heavy machinery is likely to compact the soil thereby destroying its structure.
- Adding manure and other organic matter to produce a cementing effect.
- Avoiding overgrazing which exposes the soil to erosion.
- Rotating the growing of crops.

- Leaving the ground fallow so that the soil rebuilds itself.

3. SOIL COLOUR: This tells us about the soil's aeration and drainage and also indicates the amount of organic matter in the soil e.g.

- A soil which contains a lot of iron oxides is usually red, brown or yellow in colour.
- Soil which is rich in quartz tends to be whitish or greyish - white.
- Soil containing a lot of organic matter or humus is dark or black in colour
- A soil which is poorly - drained or water - logged looks greyish while the one which is well - drained looks brown, red or yellow in colour.

4. SOIL TEMPERATURE: This affects the following:

- (a) Seed germination.
- (b) Transpiration and evaporation.
- (c) **Root** growth.
- (d) Chemical reactions **in the soil**.
- (e) Activities of soil micro - organisms.

There are a number of factors that affect **soil** temperature like soil colour, vegetative cover and slope **of the land** i.e.

- Dark soils absorb **more** heat from the sun.
- Bare soil warms up easily during the day and cools off quickly at night.
- A garden which slopes towards the north, if it is in the Southern Hemisphere, is heated more than that which faces south.

HOW SOIL TEMPERATURE CAN BE CHANGED

- Practise mulching of crops (spreading leaves, dry grass or other vegetative matter on the soil),
- Planting vegetative cover, iii. Irrigating crops, iv. Draining the soil.

5. SOIL CONSISTENCY:

This **refers to** the state of soil under different moisture conditions e.g.

- Soil tends to be loose when dry as in sandy soils.
- When soil is moist and pressure is applied, it tends to be friable (easily crushing).
- Wet soil tends to be sticky or plastic especially clay soil

NB: Soil consistency changes with the amount of water present in the soil. Consistency affects the workability (ability to be cultivated) of the soil. Soil consistency can be modified by draining the soil thus when it is water - logged.

6. SOIL DEPTH: Soils which are well - developed tend to be deep.

7. POROSITY: This is the condition of allowing a liquid to pass through an object. In soil, this is due to the amount of water and air spaces. Porosity influences air and water movement in the soil. The sum total of pore spaces and solid particles of the soil is referred to as **bulky density**. The formula to find bulky density is

$$BD = W/V$$

BD - Bulky density, W = weight of oven dry soil and V = Volume of oven dry soil. To determine the bulky porosity of the soil, we use bulky density as follows:

$$\% \text{ Porosity} = \frac{100 - \text{bulky density}}{\text{bulky density}} \times 100$$

Particle density (density of soil particles)

TOPIC 2: CHEMICAL PROPERTIES OF SOIL

SOIL pH: This is the term used to describe the acidity or alkalinity of soil also referred to as **soil reaction**. The ions that determine the soil pH are hydroxyl ion (OH⁻) and hydrogen ions (H⁺). Soil PH is usually measured using a **pH meter**. It can also be measured using a **Universal indicator**.

FACTORS AFFECTING SOIL pH

- Leaching: During heavy rainfall, some plant elements e.g. calcium is brought deep down the soil thereby increasing soil acidity.
- The use of acid- forming fertilisers e.g. sulphate of ammonia increases soil acidity.
- Microbial activity: This increases soil pH as hydrogen ions are released during the decomposition of organic matter.
- Weathering of parent material: Soil pH is increased if the parent material contains sulphur through the formation of sulphuric acid.
- Nutrient uptake by plants: As nutrients are absorbed by the plants, the lost nutrients are replaced by hydrogen ions which lower the soil's acidity.
- Poor drainage: Sandy soils are more prone to leaching than clay soils therefore pH tends to be lower in sandy than clay soils.

THE IMPORTANCE OF SOIL pH IN CROP PRODUCTION

- It determines what types of crops to grow in a particular area e.g. tea and pine apples do well in acidic conditions while beans and peas do well in alkaline soils. Maize and wheat favour moderate pH (pH6 and pH7).
- Microbes such as bacteria become active when soil pH is above 5.5, while fungi tolerate a wide range of pH.

FACTORS AFFECTING THE CHEMICAL PROPERTIES OF SOIL

- The composition of the soil itself: The inorganic and organic constituents of the soil affect the ability of the soil to retain and release plant nutrients.
- Soil structure and texture: These affect the status of the soil by influencing the physical, chemical and biological properties of soil
- Farming practices: These include
 1. Bush fires which destroy organic matter essential for improving soil structure and releasing nutrients. They also destroy the vegetative cover which protects the soil from erosion. Plant elements are also lost in form of gas.
 2. Overgrazing removes the vegetative cover and nutrients are lost through erosion.
 3. Improper use of machinery destroys soil structure.
 4. Monocropping exhausts certain elements in the soil.
 5. Soil acidity: It affects both release of nutrients and microbial activities.
 6. Crop removal: This leads to loss of nutrients since nutrients are removed together with crops as they are being harvested.
 7. Leaching: Soluble nutrients are washed away during heavy rainfall.
 8. Soil erosion: Top soil is washed away.
 9. Use of chemical fertilisers: Some fertilisers are acid forming and affect the availability of other nutrients.

CATION EXCHANGE CAPACITY (CEC)

This refers to the ability of the soil to exchange cations (at a given pH) e.g. when lime is added to acidic soils the calcium and magnesium in the lime will replace the hydrogen ions thereby raising the soil pH. This improves soil conditions.

SALINITY: This is the condition of soil that is associated with the accumulation of soluble salts in the soil. Examples are nitrates and sulphates.

WHY SOILS BECOME SALINE

- Irrigating virgin land with poor quality irrigation water.
- The application of fertilisers which may lead to build up of salts.
- Soil being released into the soil because the parent material contains salts.
- Low rainfall and evaporation: This is due to limited leaching.
- Poor drainage.

SODIC SOILS: These are the ones which contain high amounts of sodium. Some areas in Chikhwawa, and Mzimba contain sodic soils.

SALINE - SODIC SOILS:

These are soils which contain both soluble salts and sodium salts. Such soils are toxic (poisonous) to plants.

EFFECTS OF SALT ACCUMULATION

- They lead to an increase in the soil pH.
- It affects seed germination and plant growth in the following ways:
- High osmotic pressure reduces the plant's ability to suck water.
- It reduces the permeability of soil by water and air due to high levels of exchangeable sodium.
- Salts may be toxic to plants.

MANAGING SALINE SALTS

- Irrigate soil by flooding. This flushes out the salts.
- Drain the water as salts are carried away during the drainage process.
- Apply gypsum which helps to convert insoluble carbonate salts into sulphates which easily get leached.
- Prevent or reduce evaporation.
- Growing salt - tolerant crops e.g. beans.

IMPROVING CHEMICAL PROPERTIES OF SOIL

This can be done by following good farming practices e.g.

- Liming to increase soil acidity
- Applying organic matter to improve soil structure.
- Applying fertiliser correctly.
- Practising both physical and biological soil conservation measures.
- Practising crop rotation.
- Controlling bush fires.
- Planting close - growing crops or grass to check erosion.
- Mulching crops to reduce raindrop impact and retain soil moisture.
- Practising mixed cropping.

TOPIC 3: SEED AND PLANTING MATERIALS

A seed is a mature fertilised ovule. It is produced sexually i.e. the male and the female gametes unite to produce an offspring.

STRUCTURE OF A LEGUME SEED – BEANS

- Funicle - a short stalk which attaches the bean seed into the inside of the pod also used as a food passage for the developing seed.
- Hilum - A black scar where the funicle was attached.
- Testa - The seed coat which protects the embryo against injury and entry of pathogens.
- Micropyle - A tiny hole which allows air to pass through for the respiration of the embryo.
- Cotyledons - A pair of seed leaves which contains food for the growing embryo.

NB: Seeds with two cotyledons are known as **dicotyledonous seeds or dicots** e.g. beans, groundnuts.

- Radicle - Part of the embryo which forms the primary root.
- Plumule - The other end of the embryo which grows into a young shoot i.e. first leaves and terminal.
- Hypocotyl - Middle part of the embryonic structure which develops into a stem.

THE STRUCTURE OF A CEREAL SEED

- Fused pericarp and testa - It protects delicate internal parts of the grain.
- Point of attachment to the cob - It attaches the grain to the cob.
- Endosperm - It supplies food for germination and development of the embryo. All seeds containing this part are called **endospermic seeds**.
- Radicle - Develops into a primary root.
- Hypocotyl - develops into a stem.
- Plumule - Develops into first leaves.
- Coleorhiza - Forms a protective sheath enclosing the roots.
- Coleoptile - It protects the shoots as it pushes through the soil.
- Scutellum - It forms the outer rim of the embryo. Since there is only one cotyledon, seeds in this group are called **monocotyledonous seeds or monocots**. Examples are maize, rice and sorghum.

PLANT PROPAGATION

1. SEXUAL PROPAGATION:

This is the multiplying of plants by using seeds.

ADVANTAGES

- Seeds are relatively cheap.
- Seeds are easy to sow, handle and prepare for planting.
- Seed is easy to store without loss of quality or quantity.
- Seeds can remain viable for a long time as long as they are safely stored.
- Seeds can easily be sown mechanically using drills.
- Seeds minimise the risk of disease transmission from parents to offsprings.
- Seeds offer the only way of propagating crops that can not be propagated vegetatively.
- Seeds produce new plants that differ from their parents leading to crop improvement.

DISADVANTAGES

- It can produce serious variation and off- types among the offsprings.

- It requires a long juvenile period before bearing fruits.
- It requires preparation of the place for sowing.

2. ASEXUAL PROPAGATION:

This is the production of new plants vegetatively without using seeds hence called **vegetative propagation**.

VEGETATIVE PLANTING MATERIALS

A. Cuttings: Stem cuttings (setts) of sugarcane, cassava are in this type.

B. Runners: This is a stem which grows along the ground e.g. sweet potatoes and star grass.

C. Stem tubers: This is where the swollen portion of the plant is buried **into the ground e.g. Irish potato**.

D. Suckers: A sucker is a shoot arising from an axillary bud at the base of a parent plant e.g. bananas and pineapples.

E. Bulbs: These are made up of closely packed fleshy leaves e.g. onions, garlic.

F. Corms: This is a thickened base of an underground stem.

G. Rhizomes: These are thick, horizontal underground stems e.g. bamboos.

H. Layering: This is where a branch of a fruit tree or shrub is pegged to the ground so that it develops roots for a new shoot while it is still attached to the plant.

I. Budding: This is where a vegetative bud from one plant is transferred and joined to the stem of another plant where it develops into a new shoot.

J. Grafting: This involves joining part of one plant (a scion) to another plant (a stock) so that one can have the good qualities of two different parents.

ADVANTAGES OF ASEXUAL PROPAGATION

- It reduces the juvenile period of the plant as vegetatively propagated materials assume the age of their parent.
- It eliminates the problem of dormancy which is common in some seeds e.g. those that need scarification in order to germinate.
- It ensures genetic uniformity since all offsprings will resemble their parents.
- It is the only way of propagating crops whose seeds are not viable.
- Vegetative organs are more hardy than seedlings from seeds i.e. they can withstand environmental hazards.
- Vegetative organs have sufficient food reserves for easy establishment of the young shoot.
- Vegetative planting materials are readily available to the farmer from the previous crop.

DISADVANTAGES

- The risk of disease transfer to the young one is high.
- It is difficult to introduce variation making crop improvement difficult,
- Vegetative planting materials are bulky (in large quantities) compared to seeds,
- Some of the procedures in vegetative propagation require specialist knowledge.

TOPIC 4: PLANT PARTS AND THEIR FUNCTIONS

1. ROOT SYSTEM

A. Tap root: There is a clearly identifiable main root or primary root. Secondary (lateral roots) develop from the tap root and tertiary roots develop from the secondary roots. Tobacco, tomatoes and carrots have this type of roots.

B. Fibrous roots: All roots grow from the base of the stem. All grasses and cereals have this type.

THE INTERNAL STRUCTURE OF A ROOT

- **The root cap** - A layer of cells at the tip of the root which protect the apical meristem.
- **The apical meristem** - A bundle of tissues in the root tip from where other parts of the root develop.
- **The epidermis** - The outer layer of the cells which protects the root.
- **Root hairs** - They absorb water and minerals from the soil.
- **The cortex** - A group of cells for food storage.
- **The endodermis** - A layer of cells which separate the cortex and the vascular bundles.
- **Phloem** - Cells which transport products of photosynthesis for respiration and food storage (in roots).
- **Xylem** - Cells which transport mineral salts and water absorbed by root hairs upwards (to stems).

FUNCTIONS OF ROOTS

- To anchor (support) the plant from lodging.
- To absorb mineral salts and water.
- To store food - roots store food made in the leaves through photosynthesis. In other crops, the stored food is the harvestable part of the plant.

2. STEMS: A stem has nodes (slightly enlarged areas along the stem) and internodes (the space between two successive nodes). Branches, leaves or flowers arise from buds.

INTERNAL STRUCTURE

A. Epidermis - This is the outer surface of the stem which surrounds the cortex, which surrounds the vascular tissue, phloem and xylem).

B. Cambium cells: They produce secondary phloem and xylem through cell division thereby increasing the diameter of the stem.

C. Phloem - They transport food manufactured in the leaves downwards to all parts of the plant.

D. Xylem - Conduct water and mineral salts from the roots to branches, leaves or flowers.

FUNCTIONS OF STEMS

- To conduct food, water and mineral salts from the roots.
- To support and protect the upper plant parts e.g. branches, leaves.
- To display leaves and flowers so that they are exposed to sunlight for photosynthesis.
- To store food - Some stems are used as planting materials which store food for the developing shoots.
- To manufacture plant food - Young stems contain chlorophyll so that they are able to make sugar and starch in leaves.

3. LEAVES EXTERNAL STRUCTURE

- The blade or lamina
- The stalk or petiole which holds the blade.
- The basal sheath which connects the leaf to the stem in the cereal crop.

INTERNAL STRUCTURE

- The upper and lower epidermis - These are layers on the leaf blade which are smooth or hairy.
- Guard cells - They control opening into the leaf.
- Stomata - These are gates or openings into the leaf found between a pair of guard cells. They also release water into the atmosphere through transpiration. When guard cells have little water, the stomata close.
- Palisade cells - This is where chloroplast is found to trap sunlight.
- Spongy layer - This is where the products of photosynthesis are first stored.
- Vascular tissue - These are used for transporting food from the leaf to all parts of the plant and transporting water and mineral salts to the rest of the leaf.

FUNCTIONS OF LEAVES

- Photosynthesis - Chloroplasts contain chlorophyll, which absorb light energy essential for manufacturing sugar starch.
- Transpiration - Leaves release excess water into the atmosphere through the stomata.
- Respiration - The stomata allow the exchange of carbon dioxide and oxygen between the plant and the atmosphere.

4. FLOWERS: This is the reproductive part of the plant.

PARTS AND FUNCTIONS

- The calyx - It protects the upper part of the flower.
- The receptacle - It holds the upper part of the flower.
- The corolla - Made up of petals which attract insects that collect nectar thereby pollinating the flower. Stamens - These are male parts of the flower. It has anthers which contain pollen grains when ripe.
- The pistil - This is the female part of the flower which has a part called ovaries that contain ovules. A stalk called style extends from the ovary to the flat tip called stigma.

NB: - The transfer of pollen from anthers to the stigma is called **pollination**.

- In some parts where the anther and the stigma are on the same plant, there is **self-pollination**.

- When the transfer of pollen occurs between different plants, it is called **cross-pollination**.

- The fertilised ovule is the seed and the ovary containing the seed is a fruit.

TOPIC 6: WEEDS AND WEEDING

A weed is an unwanted plant. Weeds can be classified according to:

1. Leaf shape

- Narrow - leaved weeds: They have narrow leaves with parallel veins. Examples are Guinea grass and couch grass.
- Broad - leaved weeds: They have broad leaves with net veins. Examples are blackjack and pig weed.

2. Life span

- Annuals: These weeds complete their life cycles in one growing season.
- Biennials: These weeds require two growing seasons to complete their life cycle. They grow vegetatively in the first season and produce seeds in the second season and die e.g. carrots.
- Perennials: These live longer than two years. They produce new plants year after year.

3. Feeding habits

- Some weeds are parasitic i.e. they depend on food from the crop that is in the field e.g. witch weed penetrate roots of maize.
- Others are non- parasitic i.e. they manufacture their own food.

4. Preferred habit

- Some weeds are aquatic i.e. they are adapted to grow in water or water - logged soils which some are non - aquatic i.e. they can not complete their life cycle in such environments.

5. Seed type

- All flowering plants (angiosperms) are in the group of monocotyledonous and dicotyledonous plants.

THE IMPACT OF WEEDS

- (a) Decreasing the quantity of crop yields: Weeds compete against crops for mineral nutrients, water, light and space and this makes crops suffer.
- (b) Reducing the quality of crops: This can be done through contamination or adulteration e.g. during the harvesting of cotton, the lint may be mixed with debris.
- (c) Harbours pests and diseases of crop plants: The weeds provide suitable environment and food for the pests and pathogens (disease —causing organisms) to thrive and multiply.
- (d) Smothering crop plants: Weeds suppress the growth of crops because they become established faster and more aggressively than crop plants. They therefore make it difficult for the crop to carry out photosynthesis as it is shaded from sunlight.
- (e) Increasing production costs: Fields with higher weed population will need more labour to harvest and controlling the weeds might also be expensive.
- (f) Reducing the value of agricultural land: Weeds are generally heavy feeders as such, they lower the nutrient status of the soil.
- (g) Poisoning livestock: some weeds e.g. fire ball, lantana cause illness or death to farm animals.
- (h) Increasing the cost of water management: Aquatic weeds interfere with the use of water for irrigation, transportation and fish farming because they:
 - * Block the flow of irrigation water in channels.
 - * Cover the surface of a fish pond completely.
 - * Choke rivers if not controlled.

METHODS OF CONTROLLING WEEDS

1. PHYSICAL CONTROL:

This involves uprooting by hand. This method can be successful if:

- * Weeds are uprooted before flowering to prevent seed multiplication.
- * Weeds are uprooted before their roots intervene with those of crop plants.
- * The uprooted weeds are effectively disposed of so there is no chance of regeneration.
- * The soil is moist enough to enable the uprooting of the entire weed.
- * The weather is sunny so that the uprooted weeds will quickly dry out and die.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Efficient for removing weeds on planting stations without any injury to crop plants. 	<ul style="list-style-type: none"> • Very slow and not suitable for large farms

<ul style="list-style-type: none"> • Requires little or no investment in farm tools 	<ul style="list-style-type: none"> • It is very tiresome
<ul style="list-style-type: none"> • Requires no specific skills 	<ul style="list-style-type: none"> • May not be effective if the weeds break up leaving the roots to produce new shoots
<ul style="list-style-type: none"> • Is cheap where labour is in large numbers 	<ul style="list-style-type: none"> • May result in transplanting the uprooted roots if they are not effectively disposed off.
<ul style="list-style-type: none"> • Sure way of killing weeds if the entire root system is removed 	<ul style="list-style-type: none"> • The weeds have enough time to use the crop food as hand weeding waits until the weed is at a stage where it can be gripped firmly and pulled out.

2. CULTURAL CONTROL:

This involves the use of cultural husbandry practices which help the crop to grow faster than the weed. The practices include:

- Burning as land - clearing practice.
- Deep tillage so that weed seeds are buried deep thereby taking long to germinate.
- Flooding in rice fields to control non- aquatic weeds.
- Crop rotation so that the lifecycle of the weeds is disturbed.
- Early planting so that crops mature earlier than weeds.
- Correct spacing to ensure adequate ground cover so that weed growth is suppressed.
- Correct fertiliser placement so **that** crops grow faster than **weeds**.

ADVANTAGES

- * Easy to use
- * Cheap
- * Does not require extra effort as normal husbandry practices are used The disadvantage is that it does not control all the weeds.

3. MECHANICAL CONTROL:

This involves the use of farm machinery including farm tools to directly remove or kill the weeds. Examples are:

- * Slashing to cut down weeds: This only slows down the growth of weeds so that the established crop can compete more successfully by smothering the weeds.
- * Hoeing out weeds: This exposes the weeds to sun's heat.
- * Using sickles and lawn mowers.
- * Using ox - drawn or tractor - drawn implements like cultivators also exposes them for drying.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Faster so large plots can be weeded in time 	<ul style="list-style-type: none"> • Expensive since it uses equipment
<ul style="list-style-type: none"> • Less tiring than physical weeding 	<ul style="list-style-type: none"> • May not completely eliminate weeds
	<ul style="list-style-type: none"> • May require skill to use some of the equipment
	<ul style="list-style-type: none"> • May result in some crops being cut down

	<ul style="list-style-type: none"> • Can not control weeds within the rows of crops
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4. BIOLOGICAL CONTROL:

This is the use of natural enemies of weeds e.g. animals, insect pests and plant pathogens to keep the weed population in check.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Makes use of natural enemies 	<ul style="list-style-type: none"> • Requires careful attention to maintain a balance between the pest and the weed
<ul style="list-style-type: none"> • Does not require any labour other than just introducing the pests into the field 	<ul style="list-style-type: none"> • It is difficult to breed host-specific pests for weed control
	<ul style="list-style-type: none"> • Can not be used to eradicate (get rid of) weeds

5. CHEMICAL METHOD:

This is the use of substances or compounds which destroy the unwanted plants. The weed killers are also known as **herbicides**.

CLASSIFICATION OF HERBICIDES

A. According to use:

1. *Selective herbicides*: They destroy plants of a particular group without harming other plants in the mixed population e.g. Dalapon kills monocots while dichloroacetic acid kills dicotyledonous plants.

2. *Non-selective herbicides*: These kill any plant. An example is paraquat.

B. Mode of action: The three main groups include:

1. *Contact herbicides*: These kill weeds only when they are in direct contact with them e.g. Bentazone and Propanil in rice fields.

2. *Translocated (systemic) herbicides*: These are absorbed by plants through leaves or roots and are translocated to other plant parts through the vascular system (phloem and xylem) e.g. Atrazine.

3. *Soil sterilants*: These are applied to the soil to prevent the growth of weeds e.g. Bromacil.

C. Time of application: Those classified in this way include:

1. *Pre-planting herbicides*: Applied before the crop is planted e.g. methylbromide.

2. *Pre-emergence herbicides* e.g. lasso.

3. *Post-emergence herbicides* e.g. 2, 4-D chemical.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Reduces early weed competition through pre-emergence herbicides 	<ul style="list-style-type: none"> • High herbicide concentration can damage crops
<ul style="list-style-type: none"> • Reduces labour demand for weeding 	<ul style="list-style-type: none"> • Some herbicides are harmful to

	people
<ul style="list-style-type: none"> Enables the cultivation of large areas without the fear of weeds 	<ul style="list-style-type: none"> They may be highly diluted and become ineffective
<ul style="list-style-type: none"> Ensures timely control of weeds 	<ul style="list-style-type: none"> They require proper training in handling and application

6. LEGISLATIVE WEED CONTROL:

This involves passing laws to control weeds and their spread.

Such laws provide for:

- Inspection measures at entry points like airports, harbours, ports to ensure that those entering do not carry weed seeds.
- Quarantines to ensure that suspicious goods that may contain weed seeds are observed for a reasonable period.
- A mechanism for reporting and controlling weeds

Advantages	Disadvantages
<ul style="list-style-type: none"> Prevents strange weeds from being introduced into the country 	<ul style="list-style-type: none"> Is not very effective since smuggling of goods is common
<ul style="list-style-type: none"> Is free to the farmer 	<ul style="list-style-type: none"> Is difficult to enforce
	<ul style="list-style-type: none"> Does not control weeds on individual farms
	<ul style="list-style-type: none"> Only covers a few seeds

TOPIC 7: PROTECTING CROPS AGAINST PESTS AND DISEASES

- Crop protection means keeping cultivated plants safe from organisms that could cause damage and a reduction in crop yields and the farmer's income.
- A pest is an organism that causes damage to crops e.g. a grasshopper eats plant leaves.
- A disease is a physiological or anatomical disorder or abnormality in a plant which can be identified through characteristic symptoms on the plant.

COMMON PESTS

A. Mammals: These include monkeys, rat, and warthogs.

B. Birds: These include guinea fowl, weavers and red-headed quelea.

C. Nematodes: These are microscopic roundworms also known as eelworms which cause knots on root crops, causing a lot of damage.

D. Insects: These are divided according to the kind of mouth parts that they have e.g.

1. **Biting and chewing insect pests:** These have a pair of powerful mandibles (sharp blades) for cutting and chewing the plant parts. Examples are grasshoppers, cutworms, and termites.

2. **Piercing and sucking insects:** Their mouthparts have a sharp needle-like **stylet** (proboscis) which penetrates plant tissues (leaves or fruits) to suck the juices e.g. aphids, cotton stainers and fruit flies.

3. **Boring insects:** These have mouthparts adapted for biting and chewing by making tunnels (drills) into the stems, fruits or seeds e.g. stalkborer and weevils.

HARMFUL EFFECTS OF PESTS

(a) **They transmit diseases because they:**

- Act as vectors (disease carriers) thereby transmitting pathogens such as viruses from one plant to the other.
- Inject toxic saliva and other substances into plant tissues.
- Pierce plants, encouraging secondary infection.

(b) Lowering the quality of yields by:

- Puncturing fruits or seeds, making them unmarketable.
- Blemishing the produce.
- Contaminating the produce through excreta or eggs.

(c) Reducing the quantity of yields by:

- Eating roots or causing root-rot disease thereby disturbing mineral absorption.
- Boring stems which interferes with the movement of manufactured food from leaves and mineral nutrients from roots to other parts of the plant.
- Eating plant leaves which reduces the area of photosynthesis so that the plant fails to manufacture enough glucose.
- Consuming fruits or seeds and leaving a little or nothing for the farmer.
- Eating flowers which affect pollination/fertilisation.
- Destroying apical buds (growing points) resulting in stunted growth.

(d) Increasing the cost of production by:

- Causing a farmer to buy pesticides.
- Demanding time for crop inspection, planning when and how to control the pest, grading contaminated produce.

COMMON DISEASES: Root rot which affects citrus fruits, maize streak and anthracnose which affects mangoes are some of the diseases.

HARMFUL EFFECTS OF DISEASES

- Damaging roots which increases the incidence of lodging.
 - Injuring roots through root knots which reduces the capacity for mineral and water absorption.
 - Disturbing the flow of water and nutrients through the stem to other plant parts.
 - Leaf diseases interfere with photosynthesis
 - Interfering with pollination.
- Reducing both the quality and quantity of fruits and seeds.

METHODS OF CONTROLLING PESTS AND DISEASES

I. PHYSICAL METHOD:

This is the use of direct human effort or mechanical devices to remove or destroy the pests and diseases or make the environment unsuitable for them. The methods include:

- Hand picking: Large caterpillars can be collected by hand and crushed.
 - Fencing: Enclosures are erected to protect crops from mammals.
 - Frightening off pests: This can be by using the sound of firing devices, or the sight of human shape.
- Painting sticky bands: These are substances smeared at the base of trees to prevent insect pests from crawling up.
- Erecting concrete foundations: This keeps away termites from grain stores.
 - Flooding fields: Caterpillars and soil pests are killed by suffocation (asphyxiation).

- Using rat guards: Fixing metal collars around supports of storage structures prevents rats from crawling up.
- Trapping: Birds, mice and insects are caught by trapping.
- Using air-tight storage facilities: This ensures that there is little oxygen left for the pests.
- Chilling (keeping very low temperatures) and heating (keeping very high temperatures) prevents multiplication of some pests and pathogens.

2. CULTURAL CONTROL METHODS

This is the use of normal crop husbandry practices to prevent or reduce the multiplication or spread of pests and diseases. Some of the methods are:

- Tilling the soil: This destroys some soil pests or soil-borne diseases by exposing them to the surface where the sun or predators can kill them.
- Crop rotation: Since most pests and diseases are specific, changing of growing crops will disturb their life cycle.
- Early planting: This ensures that crops are well established before pests and diseases build up to dangerous levels.
- Planting clean healthy seeds
- Removing volunteer plants: This will encourage pests and diseases of the previous crop to remain on the plot.
- Weeding early
- Maintaining a recommended plant population so as to have a good cover which will slow down the movement of pests.
- Applying manure and fertiliser properly: This keeps the crops so healthy so that resisting pests and diseases becomes easy.
- Destroying crop residues: This reduces the carry-over of pests and diseases from one season to the other.
- Intercropping or mixed cropping: This makes pests and diseases of one crop to be a barrier of the pests and diseases

3. LEGISLATIVE CONTROL: This is the use of laws and regulations to prevent dangerous pests and diseases from being imported into the country. Such methods include:

- **Prohibition:** This is where laws or regulations are made country-wide forbidding the introduction of specific agricultural materials that may be a source of infection in the area.
- **Quarantine:** This is a period of isolation and observation of materials in sealed compartments long enough for any disease symptoms to appear.
- **Notification order:** This requires reporting of the occurrence of dangerous pests and diseases to appropriate authorities.
- **Closed season:** This is observation of a free period for planting of a crop.
- **Seed certification:** This is putting regulations to ensure that crops are inspected and certified free of pests and diseases.

4. BIOLOGICAL CONTROL:

This is the use of living organisms such as predators, parasites and pathogens to reduce the population of pests. This includes:

- **Predators:** These are animals which prey on others' e.g. chickens eat army worms.
- **Parasites:** These are organisms which live on other organisms for food
- **Pathogens:** This is the introduction of pathogens on the pests to control their population.

ADVANTAGES

- A relatively cheap method.
- It is effective for several years.
- It does not pollute the environment

DISADVANTAGE

- It requires expertise and thorough knowledge of the ecosystem and behaviour of both the pest and the controlling agent.

5. CHEMICAL CONTROL: This is the use of toxic substances that are dangerous to crop - pests, parasites and pathogens.

TYPES OF CHEMICALS

Type of pest	Type of pesticide
Insects	Insecticides
Mites (acarina)	Acarides
Nematodes	Nematicides
Snails (molluscs)	Moluscides
Rats or mice (rodents)	Rodenticides
Bacteria	Bactericides
Fungi	Fungicides
Viruses	Virucides
Parasitic weeds	Herbicides

METHODS OF APPLYING PESTICIDES

- i. **Dusting:** This involves applying pesticides in form of powder e.g. aldrin
- ii. **Fumigating:** This involves applying pesticides in form of smoke or gas e.g. methyl bromide.

MODE OF ACTION

A. Contact poisons: They kill the pest when it touches the pesticide.

B. Stomach poisons: They kill the pest by entering the stomach while eating.

C. Respiratory poisons: They enter the pest through its respiratory system and interfere with its breathing.

D. Systemic poisoning: Are applied to the soil or leaves and are absorbed by plant roots.

Advantages	Disadvantages
<ul style="list-style-type: none"> • Can be completed quickly • Pests are killed instantly 	<ul style="list-style-type: none"> • It is expensive to buy chemicals • It can end up killing beneficial organisms
<ul style="list-style-type: none"> • It is used only when necessary 	<ul style="list-style-type: none"> • It pollutes the environment
<ul style="list-style-type: none"> • Individual farmers can effectively use the method 	<ul style="list-style-type: none"> • It requires repetitive application to kill the larvae or adult
<ul style="list-style-type: none"> • It is more dependable than legislative where people can choose to disobey the Law 	<ul style="list-style-type: none"> • Some pests develop resistance to pests
<ul style="list-style-type: none"> • Easy to use since it has instructions on the label 	<ul style="list-style-type: none"> • It is harmful to people hence need to have a lot of caution during and after application

TOPIC 8: CROPPING SYSTEMS

This refers to the patterns, techniques, procedures or practices followed in the cultivation and production of plants.

1. SHIFTING CULTIVATION:

This is the cropping system whereby land is cultivated for several years until the crop yields become too low due to soil exhaustion.

ADVANTAGES

It is cheap since it does not require fertilisers.

- It is simple since operations are generally carried out using hand tools.
- It controls pests and weeds effectively through burning the bush.

DISADVANTAGES

- It requires a lot of land for the shifting process.
- It results in low yields due to the absence of fertilisers.
- The burning of vegetation destroys potential organic matter and some nutrients.
- It exposes land to erosion since vast areas have to be cleared.

2. BUSH FALLOWING:

This means farming a plot then temporarily leaving it when exhausted so that it can regain fertility before returning to it later.

ADVANTAGES

- > It is cheap as it does not need a lot of capital for fertilisers.
- > It maintains soil fertility through the fallow periods.

DISADVANTAGES

- > It encourages deforestation as one bush is cleared after the other.
- > It increases the rate of soil erosion through careless cutting down of trees.
- > It requires a lot of land which the farmers may not have.

3. MONOCROPPING: This involves identifying one crop that is most suitable for the area.

Advantages	Disadvantages
<ul style="list-style-type: none">• It produces highest profit since farmers grow only the most suitable crop.	<ul style="list-style-type: none">• Pests and diseases build up since the farmer grows the same crop all the time
<ul style="list-style-type: none">• It simplifies farm management since the farmer's efforts concentrate on one crop	<ul style="list-style-type: none">• The risk of disappointment is high in case of crop failure or low price.
<ul style="list-style-type: none">• It facilitates farm mechanisation since machines can be permanently adjusted	<ul style="list-style-type: none">• The soil becomes exhausted quickly since one crop uses the same nutrients every year
<ul style="list-style-type: none">• It saves costs since inputs can be bought in bulk at wholesale price	
<ul style="list-style-type: none">• It reduces the amount of starting capital	

<ul style="list-style-type: none"> • The farmer specialises and becomes an expert in one crop 	
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4. MONOCULTURE: This means cultivating only one crop during that particular growing season. The plot on which the crop is grown is known as **pure stand**.

ADVANTAGES

- It facilitates the use of machinery since they can be adjusted to suit the crop in the pure stand.
- It eliminates the possibility of competition from other crops.
- It is easy to use chemicals since the farmer has only the needs of one crop

DISADVANTAGE

- It increases the spread of pests and diseases.

5. MIXED CROPPING:

This is the growing of two or more crops on the same plot at the same time. It is also called intercropping, interplanting, multiculture or polyculture

TYPES OF MIXED CROPPING

A. Intra-row mixed cropping: Two or more crops are grown within the same row either on the same planting station or different stations.

B. Inter-row mixed cropping: One crop is grown between the rows of another crop i.e. on alternate ridges.

C. Relay intercropping/ phased planting: A second crop is sown on the plot while the first one is still growing, established or even maturing.

ADVANTAGES

- It saves labour since some operations are done at once for all the crops.
- It saves land since the same land is used for more than one crop.
- It increases the total yield per hectare since the harvest is combined.
- It reduces the risk of crop failure since the farmer can rely on the other crop if one fails.
- It enables the crops to benefit from one another e.g. beans fixing nitrogen for maize.
- The mixture provides adequate soil cover which reduces erosion and weed growth.

DISADVANTAGES

- Mechanisation is difficult since each crop has specific needs.
- It requires large starting capital to get different machines and farm structures for different crops.
- It is difficult to use pesticides since a chemical used on one crop might be harmful to the other.
- It requires a wide range of knowledge and skills to manage different crops.
- Different crops might be shading one another reducing the rate of photosynthesis.

6. CONTINUOUS CROPPING:

This is the practice of growing crops on a piece of land every year without resting the land.

ADVANTAGES

- It ensures 100% utilisation of the land resources available.
- It serves the soil since land is under cover all the time.
- Ensures food security and cash since the farmer gets harvests every year.

DISADVANTAGES

- It exhausts soil fertility since nutrients are removed every year.
- Soil structure is destroyed due to over-cropping.
- Multiplication of diseases, parasitic weeds and pests is high.

7. CROP ROTATION: This is the practice of growing different crops (changing crops) on a piece of land in a particular order every year. The farm is divided into pots depending on the number of crops to be grown.

PRINCIPLES OF CROP ROTATION

- Alternating tap (deep) rooted crops with fibrous (shallow) rooted crops.
- Alternating leguminous crops (beans, g/nuts) with non-leguminous crops (cereals, cotton).
- Alternating heavy feeders (soil-exhausting crops) with light feeders.
- Alternating crops with good soil cover with those having little soil cover.

Advantages	Disadvantages
<ul style="list-style-type: none">• Ensures that crops make use of nutrients from different layers.	<ul style="list-style-type: none">• Some of the crops may have low commercial value
<ul style="list-style-type: none">• Controls pests and diseases by breaking their life cycles	<ul style="list-style-type: none">• Requires more land to accommodate various crops
<ul style="list-style-type: none">• Improves fertility with the inclusion of legumes	<ul style="list-style-type: none">• Requires more labour
<ul style="list-style-type: none">• Controls parasitic weeds which are host-specific	<ul style="list-style-type: none">• Requires skills to manage different crops
<ul style="list-style-type: none">• Reduces soil erosion when cover crops are included	<ul style="list-style-type: none">• May not be practical where most of the land is to be used for growing staple food.
<ul style="list-style-type: none">• Ensures a more even distribution of labour	
<ul style="list-style-type: none">• Spreads out financial risks over different crops.	

8. NO-TILL CROPPING:

This is where the soil is cleared but neither tilled nor ridged hence also called zero tillage or minimum tillage.

ADVANTAGES

- Conserves the soil since it is not loosened by tillage.
- Saves labour since there is no ploughing and ridging.

Maintains soil structure since it is not damaged by repeated cultivations.

- Ensures that crop husbandry practices are completed on time.
- Saves money which would have been used for buying and maintaining cultivating machinery.
- Can be used effectively on hilly areas where machinery could not be used.

DISADVANTAGES

- May not improve the productivity of clay soils which require opening up.

- Herbicides are expensive

9. BIOLOGICAL FARMING:

This is where crops are grown using organic inputs rather than inorganic inputs like fertilisers, pesticides hence also called organic farming or eco-farming.

ADVANTAGES

- It prevents rivers and lakes from being polluted with fertilisers or pesticides.
- It protects useful insects which would be destroyed if chemicals were applied.
- Soil structure is improved through use of manure.
- It is cheaper to make manure than to buy fertilisers.
- It reduces the chances of poisoning
- It keeps the ecosystem in state of balance since inorganic inputs tend to be environmental-friendly.

DISADVANTAGE

- Organic inputs are slow in producing results.

TOPIC 9: FRUIT PRODUCTION

IMPORTANCE OF FRUITS

- * They are a source of valuable nutrients e.g. proteins, carbohydrates.
- * They provide people with an income after sale.
- * They provide employment i.e. some people are employed to sell fruits while others work in factories that change the fruits into other products e.g. juices.
- * They provide foreign currency i.e. they can be exported to other countries.

MANGOES

VARIETIES AND THEIR CHARACTERISTICS

Variety	Size	Timing of fruit maturity	Other general characteristics
Haden	Large (400-700 g)	Early season	<ul style="list-style-type: none"> • Suitable for hot dry areas • Well-coloured fruits with excellent flavour • Susceptible to anthracnose
Zill	Medium (300-400 g)	Early season	<ul style="list-style-type: none"> • Fruits are scarlet to dark-red when ripe • Suitable for all typical mango areas • Excellent internal quality
Irwin	Medium (up to 450 g)	Early season	<ul style="list-style-type: none"> • Suitable for most areas • Fruit is elongated and slightly flattish • Excellent internal and external quality
Davis-haden	Large (up to 900 g)	mid-season	<ul style="list-style-type: none"> • Like Haden but resistant to anthracnose

Palmer	Large (600-700 g)	Late season	<ul style="list-style-type: none"> • Produce elongated fruits • Susceptible to bacterial black spot
Kent	Large (up to 900 g)	Late season	<ul style="list-style-type: none"> • High yielding variety

			<ul style="list-style-type: none"> • Suitable for hot areas
Keitt	Large (up to 900 g)	Very late season	<ul style="list-style-type: none"> • Bears plump, thick fruits
Anderson	Large (1kg)		<ul style="list-style-type: none"> • Suitable for canning

CULTIVATING MANGOES

- They do well in deep, fertile, well-drained sandy-loam soils.
- They prefer lower altitudes
- Though they are drought-tolerant, they need a minimum rainfall of 650 mm per annum,

LAND PREPARATION

- Planting holes of 90cmx90cmx90 cm should be prepared two months in advance.
- The top soil should be mixed with 5-10kg of manure.
- Planting holes should be spaced 9mx9m, 10.5mx10.5m or 12mx12m depending on the variety and fertility of the soil.

PLANTING

- This should be done at the beginning of the rainy season (December or January) for successful establishment.
- Watering is necessary during the first year.

MULCHING:

This is necessary for conservation of moisture by reducing evaporation.

WEEDING: All weeds beneath the seedling should be cleared.

FERTILISER APPLICATION

- Apply 5-10 kg of manure at the beginning of each rainy season.
- CAN, Muriate of Potash and Triple super Phosphate can also be applied.

HARVESTING

- This should be done when the fruits are physiologically mature.
- Harvesting can be done by hand and collected in a bag.
- The fruits should not fall to the ground to avoid bruising.

PESTS OF MANGOES

Pest	Damage	Control
Mango stone weevil	<ul style="list-style-type: none"> • Early falling or rotting • Development of hard white areas inside 	<ul style="list-style-type: none"> • Collect and bury dropped fruits » Keeping the orchard clean
Mango scales	<ul style="list-style-type: none"> • Attack the fruits leaves and stems • Produce honey dew 	<ul style="list-style-type: none"> • Spray dimethoate

	(a sticky fluid)	
Fruit flies	<ul style="list-style-type: none"> • Change the colour of the fruits before they are ripe • Parts of the flesh become liquid 	<ul style="list-style-type: none"> • Collect and bury dropped fruits » • Spray fenthion • Harvest fruits before ripening

DISEASES OF MANGOES

Disease	Symptoms	Control
Anthracnose	<ul style="list-style-type: none"> • Discoloration of young leaves • Premature ripening of fruits • Black spots on fruits • Rotting of fruits 	<ul style="list-style-type: none"> • Spray benomil
Powdery mildew	<ul style="list-style-type: none"> • Shedding of flowers and immature fruits • White substance appears on the flowers 	<ul style="list-style-type: none"> • Spray benomil

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TOPIC 10: LIVESTOCK FEEDS AND FEEDING

CLASSES OF LIVESTOCK FEEDS

1. ROUGHAGES: These are feeds with high moisture and fibre content but low in protein. They can be succulent (elephant or napier grass) or dry (hay and g/nuts haulms)

2. CONCENTRATES: These are high in protein and carbohydrates but low in moisture and fibre content. They are providers of energy required by animals. Examples are madeya, soya meal. Animals are also given mineral and vitamin supplements. These are called **additives**.

FEED RATIONS

A. Maintenance rations: This is the amount of feed that an animal needs per day to maintain its bodily processes without gaining or losing weight. It is essential for growing animals and those in gestation.

B. Production rations: These are feeds that contain all essential nutrients and in their right composition given to animals over and above the maintenance ration e.g. layers mash for chickens to produce eggs.

FORMULATING RATIONS:

- This is where farmers make their own ration to overcome the high price of commercial feeds.
- A method known as **Pearson's Square** is used.
Example: Formulate a 15% protein feed using maize containing about 10% protein bean meal containing 3 5% protein.

PROCEDURE

- Draw a square and place the desired percentage protein content of the mixed feed in the centre.
- Place the percentage of each feed stuff to be mixed at the left corners.
- Subtract the figures diagonally across the square. (Subtract the small numbers from bigger ones, disregarding the negative signs).
- Place the numbers obtained on the right corners, giving the required parts of each feed stuff. NB: According to the example, the total is 25.

FACTORS TO CONSIDER WHEN FEEDING ANIMALS

- **Age and size of the animal:**
Young animals require less feed than animals because their digestive systems are not fully developed.
- **The type of animal:** Ruminants can digest roughages unlike non-ruminants. Exotic breeds also require quality feed.
- **The purpose for which the animal is kept:** If they are kept for draught, they will require high-energy feed. Animals which are kept for milk, meat and egg production require a lot of concentrates.
- **The condition of the animal:** Milk producers should not be allowed to starve to avoid milk reduction.
- **Quality of the feed:** The feed should be easy to digest
- **Palatability:** The feed should be appetising to the animals.
- Digestibility.
- **The amount of feed:** This will depend on quality and type.
- **Texture:** This refers to coarseness or fineness of the feed
- **Cost of the feed:** Feed should be given to the animals only when they are in production e.g. layers mash when the chickens are laying eggs.

TOPIC 11: SHEEP AND GOAT PRODUCTION

IMPORTANCE OF SHEEP AND GOATS

- Sheep provide meat, wool and skins.
- Goats provide meat, milk and skins.
- They are a source of income.
- They provide manure for crop production

EXAMPLES OF SHEEP AND GOATS FOUND IN MALAWI

Type of animal	Examples of indigenous breeds	Examples of exotic breeds
sheep	<ul style="list-style-type: none"> • Malawi sheep (fat-tailed) 	<ul style="list-style-type: none"> • Black head Persian • Merino • Karakul

Goats	<ul style="list-style-type: none"> • Malawi goat • Small East African goat 	<ul style="list-style-type: none"> • Angora • British Saanen • British Alpine • Toggenburg • Boer goat
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NB: Local sheep are small, they grow slowly and their yield is low.

BREEDS OF SHEEP AND GOATS AND THEIR USES

Type of animal	Exotic breeds	Purpose for breeding
Sheep	<ul style="list-style-type: none"> • Black-headed Persian • Dorper • Merino • Karakul 	<ul style="list-style-type: none"> • Mutton (meat) • Mutton • Wool • Skin (pelt)
Goats	<ul style="list-style-type: none"> • Angora goat • British Saanen • Anglo-Nubian goat • British Alpine • Toggenburg • Boer goat 	<ul style="list-style-type: none"> • Mohair • Milk • Milk, meat • Milk • Milk • meat

CRITERIA USED TO SELECT A BREED OF SHEEP

- A. The primary use or product- The characteristics of a good mutton sheep are:
- Good mothering ability of the ewe.
 - Fast growing and mature
 - Even distribution of the body
 - Body weight: It should be above 50 kg.
- B. Adaptation to the climatic and environmental conditions:
- The local Malawi sheep is hardy and adaptable since it requires low inputs
 - The Karakul and Merino are adapted to desert conditions.
 - The Hampshire Down which is good for wool production can survive on poor pasture.

SHEEP MANAGEMENT BREEDING

- > Only health ewes (young female sheep) and rams (male sheep) should be selected.
- > It is also advisable to cross-breed local with exotic breeds to improve production.
- > Ewes can be served (mated) when they are 18-24 months old.
- > Rams can be used for breeding when they are 8 months old.
- > Rams are not allowed to move together with ewes during mating times to avoid in-breeding.
- > One ram can serve up to 60 ewes.
- > Rams not recommended for breeding should be castrated.

REASONS FOR CASTRATION

- Castrated animals fatten up quickly and produce quality meat.

- It prevents animals from mating and passing on undesirable characteristics.
- It makes the animals more docile (easy to handle).

METHODS OF CASTRATION

- Using burdizzo to crush the spermatic cords and should be done when animals are about 2-3 months.
- Using a sharp knife to cut the scrotum.
- Using a strong rubber band or elastrator to cut off blood supply to the testicles

NB: Breeding should be properly timed so that lambing takes place when there is plenty of grass i.e. mating should be done in November so that lambing is in April or early May. **OESTRUS:** This is the period of sexual activity in female animals also called **heat period**.

- It may occur when the sheep is 6-10 months old.
- It may occur between 15-19 days and lasts 18-24 hours
- Two weeks before the ewes are mated, they should be given concentrates to improve their health. This is called **flushing**.

GESTATION PERIOD: It lasts 150 days. During this period, the animals should be drenched against internal parasites and vaccinated against diseases. They should also be given some concentrates 1-2 months before lambing. This is called **steaming up**.

LAMBING AND CARING FOR LAMBS

SIGNS OF GIVING BIRTH

- The sheep becomes restless
- It leaves the rest of the flock to search for a quiet place.
- The vulva becomes red.
- There is frequent bleating
- NB: When these signs are observed, the ewes should be moved to a lambing paddock. After birth, lambs should be allowed to suckle up to 6 months.

OTHER MANAGEMENT PRACTICES

- **Castration:** This should be done after one or two months.
- **Docking (cutting of the tail)** and trimming (cutting back overgrown hooves) should be done before lambs are too old.

Docking is done for the following reasons:

- It prevents dirt and dung from collecting under the tail.
- It helps in parasite control i.e. easy to remove external parasites.
- It helps the animals to mate easily.

HOUSING

CHARACTERISTICS OF A GOOD HOUSE FOR SHEEP

It should:

- Be strongly built to prevent predators.
- Have enough space.
- Be well-ventilated and well-lit.
- Be dry and warm.
- Be easy and cheap to construct.

FEEDING SHEEP

- They mostly depend on pasture or grass.

- Supplementary feeds such as madeya should also be given.
- Mineral licks of bone meal and salt should also be provided

DISEASE AND PARASITE CONTROL

Disease	Causal organism	Symptoms	Treatment/control
Pneumonia	Bacteria or virus	<ul style="list-style-type: none"> • Loss of appetite • Coughing • Difficulty in breathing • Nasal discharges 	<ul style="list-style-type: none"> • Treat with antibiotics • Keep animals in a clean, warm well-ventilated house • Provide plenty of water and palatable feed
Pulpy kidney or lamb dysentery	bacteria	<ul style="list-style-type: none"> • Staring eyes • Tiredness • Brownish and brown-stained diarrhoea • Convulsions and sudden death in severe cases 	<ul style="list-style-type: none"> • Vaccinate animals

Heart water	Protozoa transmitted by ticks	<ul style="list-style-type: none"> • Loss of appetite • High fever • Nervousness • Animals walk in circles or hit against objects • High death rate in exotic breeds 	<ul style="list-style-type: none"> • Dipping • Treat with tetracycline in the early stages
Brucellosis (contagious abortion)	bacteria	<ul style="list-style-type: none"> • Uterus is infected and foetus dies • Abortion 	<ul style="list-style-type: none"> • slaughter and burn infected animals • vaccination
Foot rot	Fungi, bacteria	<ul style="list-style-type: none"> • feet swells and animals have difficulty in walking • feet have pus and bad smell • animals may become lame 	<ul style="list-style-type: none"> • treat with antibiotics or disinfectants • trimming hooves
Foot and mouth	virus	<ul style="list-style-type: none"> • high fever • dullness in animals • excessive salivation • lameness 	<ul style="list-style-type: none"> • restrict movement • vaccinate • slaughter and burn infected animals
Mastitis	bacteria	<ul style="list-style-type: none"> • swollen udder • clots (blood and pus) in milk 	<ul style="list-style-type: none"> • use antibiotics • cleanliness during milking use disinfectants vaccinate

Sheep pox	virus	<ul style="list-style-type: none"> • high fever • dark-red pimples • death of some lambs 	No treatment
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GOAT MANAGEMENT

HOUSING

EXTENSIVE SYSTEM:

This is where goats are free to graze natural pastures and shrubs.

INTENSIVE SYSTEM:

Under this system, there is controlled grazing where the animals are kept and fed in the khola. It is mainly used where the goats are kept for milk production.

CHARACTERISTICS OF A HOUSE FOR GOATS

It should be;

- Well-sited (on high ground).
- Cheap to construct,
- Strongly built.
- Roomy » Well-lit
- Well-ventilated and dry.
- Made of concrete floor or hardened with earth or clay.
- Well-thatched.
- Well-drained and easy to clean.

PARASITE AND DISEASE CONTROL

- Malawian goats are disease resistant but they can be carriers of internal and external parasites for other animals.
- They should be dipped, dusted or drenched to control external parasites (fleas, ticks and tsetse flies) and internal parasites like roundworms, tapeworms and liver flukes.
- Good nutrition is necessary to increase disease resistance.

SELECTING APPROPRIATE BREEDS

- The Malawi goat can be used for both meat and milk production. It can also be cross-bred to improve this production.
- Goats kept for meat production should:
- Grow fast and mature early.
- Be from nannies with good mothering ability.
- Have good body shape.

NB: For both meat and milk producers, they should be suited to the local conditions of the area.

BREEDING GOATS

- Female goats (does or nannies) should be served when they are 15-18 months old while male goats (bucks or billies) should be used when they are two years old.
- One billies can service up to 60 nannies.

THE OESTRUS CYCLE

-The length is 18-21 days and occurs for one to three days.

SIGNS OF HEAT IN ANIMALS

- The doe frequently wags her tail.
- She shows signs of excitement.
- She sometimes mounts other nannies.
- The vulva becomes red and thick.
- There is mucous discharge from the vulva.

GESTATION PERIOD

The gestation period is 150 days and the process of giving birth to young ones is called kidding.

CARING FOR GOATS

- The kids must suckle the mother for at least 3-4 days to get **colostrum** (the first yellow milk which is rich in vitamins and proteins). It also contains antibodies which are essential for providing immunity to the young one.
- The kids are introduced some pasture and feed supplements about three weeks after birth to help them develop their digestive system.
- Male kids should be castrated at the same time.

TOPIC 12: MARKETING FORCES

The price of a commodity at a perfect market is determined by forces of **demand and supply**.

DEMAND AND SUPPLY FOR BEEF AT DIFFERENT PRICES

Price (MK/kg)	Quantity demanded (kg)	Quantity supplied (kg)	Excess demand (kg)	Excess supply (kg)
90.00	5900	3600	2300	
100.00	5600	4300	1300	
110.00	4800	4800	0	0
120.00	4200	5100		900
130.00	3700	5800		2100

- At lower price, the quantity of beef demanded is higher than the quantity supplied leading to excess demand.
- At higher price, the quantity of beef supplied is much higher than the demand leading to excess supply.
- There is a point whereby the quantity demanded is exactly the quantity supplied (**equilibrium quantity**). This is also called market price e.g. in the table above, when the price is K110.00 the supply is 4800 kg and the demand is also 4800 kg.

NB: Selling agricultural commodities at a price lower or higher than the market (equilibrium) price is clearly disadvantageous to the farmer (seller).

CHANGING THE PRICE OF A COMMODITY

1. **Production costs:** This can make the price rise due to the rise in the price of inputs. It might also decrease due to use of improved low-cost technology or government incentives to farmers.
2. **Product modification:** The farmer will add substances (additives) to satisfy customers and this will eventually raise the price of the commodity.
3. **Attracting customers:** This is made to build up demand and increased sales.
4. **Competitors' prices:** The price might be lowered to match or beat or even drive out other competitors out of the market.

PRICE ELASTICITY OF DEMAND

This is the degree to which demand for a product responds to change in its price. *Example:* Determine the price elasticity of demand for beef when the price changes from K100/kg to K110/kg resulting in change in the quantity demanded from 5600 kg to 4800 kg

$$\begin{aligned}\text{Step 1: \% change in quantity} &= \frac{\text{original quantity} - \text{new quantity}}{\text{original quantity}} \times 100 \\ &= \frac{5600 - 4800}{5600} \times 100 \\ &= \frac{800}{5600} \times 100 \\ &= \frac{100}{7}\end{aligned}$$

$$\begin{aligned}\% \text{ change in price} &= \frac{\text{original price} - \text{new price}}{\text{original price}} \times 100 \\ &= \frac{100 - 110}{100} \times 100 \\ &= 10\end{aligned}$$

$$\begin{aligned}\text{Price elasticity of demand} &= 10 \div \frac{100}{7} \\ &= \mathbf{1.43}\end{aligned}$$

DEGREES OF PRICE ELASTICITY OF DEMAND

- A. **Elastic demand:** This is where a small change in the price causes a large change in the commodity demanded. Luxury commodities like beef tend to have elastic demand because consumers can survive without such products.
- B. **Inelastic demand:** This is where a change in the price has little or no response. This is true of staple commodities (necessities) or products that do not have many substitutes e.g. maize.
- C. **Unitary demand:** This is where a change in the price of the commodity results in a proportionate change in the quantity demanded. This is true of commodities that are fairly important to consumers e.g. beans, sweet potatoes.

PRICE ELASTICITY OF SUPPLY

It is the extent to which the supply of a commodity changes as result of a change in the price of that commodity.

NB: The steps are the same for calculating price elasticity of demand.

- A. **Elastic supply:** This shows that a change in the price of a commodity results in a more than proportionate (larger) change in the quantity supplied. This is true of tobacco whose quantity is increased if farmers were offered good prices in the previous year.

B. Inelastic: This is where a change in the price of a product causes a less proportionate (smaller) change in the supply. Maize is a good example of a commodity whose supply is inelastic because it is a staple food.

C. Unitary: This is where the change in the price is directly proportional (one to one basis) to the supply.

TOPIC 13: MARKETING CHANNELS AND AGENCIES

Marketing channels are the routes through which farm produces move from point of production (farmer) to point of consumption (consumer).

TYPES

1. Direct marketing channels/ One-tier marketing channel: This is where a farmer sells their produce to numerous buyers on one-one basis. Tomatoes and cabbages are normally sold in this way.

2. Indirect marketing channels/ two-tier marketing channels: In this case, a farmer sells to one middle person who in turn sells to several final consumers. Middle persons are active in the selling of goat and fruits.

3. A three-tier marketing channel: This is where the two-tier has been lengthened by adding another stage- the wholesaler and that the widening channel has also been widened by increasing the number of retailers.

MARKETING AGENCIES

These are individuals, companies or organisations that carry out the various marketing functions. These can be selling and buying, grading and standardisation, assembling, transportation e.t.c.

ROLES OF MARKETING AGENCIES

1. Producers: This is the starting point of the marketing channel where the farmer sells his/her own products. The advantage is that the consumer and the producer exchange the commodity at a price which is satisfactory to both of them.

2. Itinerant traders: These are agents who travel to various farms to buy farm produces, which they may assemble, and transport to sell to wholesalers or retailers.

3. Middle persons: These people form a link between the producer and the consumer. They fulfil a number of roles e.g.

- They link producers with consumers who may be far apart.
- They assemble the produce from tiny scattered farms.
- They have the financial capacity to buy the produce from farmers or even give loans for production.
- They have transport facilities to collect and move the product from point of production to point of consumption.
- They build up the bulk of produce at a greater risk of price fluctuation and possible deterioration due to pests and bad weather.
- They have facilities for cleaning and grading the produce to improve its quality.
- They supply important information to farmers on market trends and prices of inputs.

4. Wholesalers: These sell goods usually at lower prices in large quantities. Their roles include:

- Selling: They provide trained sales force

- Market research
- Storage: They provide warehousing facilities.
- Transportation: They provide delivery facilities.
- Financing: They give credit to retail or institutional consumers.
- Risk bearing: They take the risks by being responsible for theft or deterioration of goods.

5. Processing companies: These buy farm produces as raw materials from farmers or itinerant traders. They then process these into finished products. They also advertise their products.

6. Produce marketing co-operatives: These are associations of people formed to assemble (collect) farm produce from farmers and sell to processing companies or wholesalers.

7. Marketing companies/co-operatives: Their roles are:

- Pricing agricultural commodities like maize in consultation with government.
- Selling food crops.
- Transporting farm produce.
- Risk-bearing
- Disseminating market information to farmers and consumers.

8. Retailers: These are marketing agencies involved in the sale of commodities to the final consumer. Some of their roles are:

- Gathering a variety of commodities.
- Paying suppliers of commodities before selling them.
- Storing commodities.
- Providing information to consumers through advertising.
- Conducting market research.
- Transporting/delivering commodities.

TOPIC 14: MARKETING COSTS AND MARGINS

MARKETING COSTS: These are expenses incurred by marketing agencies or payments made to marketing agencies for their services in the marketing channel.

SOURCES OF MARKETING COSTS:

This refers to payments that are made to different agencies which have performed some functions e.g.

- * Itinerant traders may need sacks and transport since they assemble small quantities of produce
- * If they are appointed by wholesalers, they will need a commission.

MARKETING MARGINS:

This is the difference between the cost of buying the produce (from the farmer) and selling it to the consumer. It is calculated as follows:

Retail price (paid by the final consumer) - Farm gate price (price of the produce paid to the farmer)

REDUCING MARKETING MARGINS

- * Raising prices of farm produce.
- * Performing some of the marketing functions like grading.
- * Eliminating some of the marketing functions e.g. grading of beans can be avoided if pure seeds were sown.

- * Skipping some marketing agencies: The farmer can sell directly to the wholesaler or even consumer and reap all the profits.
- * Selling through a co-operative: It has more bargaining power since it sells as a group.
- * Reducing consumer prices at retail level: This can be done through bodies like Consumers' Association of Malawi (CAMA).

TOPIC 15: POPULATION DISTRIBUTION AND MARKETING

Population distribution refers to the settlement of people in an area.

POPULATION DISTRIBUTION BY LOCATION (SPATIAL): According to the 1998 census:

- 47% live in the Southern region, 41% in the Central and 12% in the Northern region.
- The largest populations were recorded in Lilongwe, Blantyre, Mzimba, Mangochi and Zomba.
- The least populated were Likoma, Chitipa, Rumphi, Mwanza and Ntchisi.
- About 14% live in the urban areas.

POPULATION DISTRIBUTION BY AGE

1.7 million were children age under five and 4.9 million were aged 18 years or more.

POPULATION DISTRIBUTION BY GENDER

- > 51 % were females.
- > Females outnumbered males in all the regions with the highest number of females in the Southern region.
- > More females live in the urban areas.

POPULATION DISTRIBUTION BY EDUCATION AND LITERACY

- 58% of the population were able to read and write.
- The highest literacy rates were in the Northern region (72%) and the Central ranked last (55%).
- In the urban areas, 79% were literate as compared to the rural areas with 54%.
- About 1/3 never attended school, 59% had attended primary school, 8% had been to secondary school and 3% had received tertiary education.

POPULATION DISTRIBUTION BY OCCUPATION/ECONOMIC ACTIVITY/INCOME

About 80% of the population was economically active with most of them being subsistence farmers in the rural areas.

EFFECTS OF POPULATION DISTRIBUTION ON MARKETING

1. PLACE

- It affects the direction of the flow of commodities: Areas with large population like urban areas are attractive markets since most of the people are consumers.
- It affects the length of the marketing channel: Direct channels are common in areas with low populations.
- It affects the method of transporting the product to the consumers: In areas with low populations, people carry produces on either their heads or bicycles.

2. PRICE

- It affects demand for marketing services: In urban areas there are many marketing services which eventually lead to price rise.

- It affects the supply of marketing services: The high prices for commodities stimulate producers to provide more and more. Later on, the prices might start lowering.

3. PROMOTION:

- It covers advertising (product promotion and sales promotion) to persuade customers to buy the product.
- It affects choice of people to target: This promotes market segmentation (dividing the market into groups of consumers who have similar needs).
- It affects the types of advertising methods used: In highly populated areas, the mass media, trade fairs and exhibitions or agricultural shows are more common. In rural areas, it involves personal selling.

TOPIC 16: FARM RECORDS AND ACCOUNTS

These are documents which remind the farmer about the various activities done as they grow crops and raise animals on the farm.

IMPORTANCE OF FARM RECORDS

They help farmers:

- To know the timing of various farming activities (land preparation, sowing, fertiliser application).
- To know when to breed animals.
- To know when to cull (removing unproductive animals). In farm planning (what, when and how to produce).
- To budget i.e. to focus on expenses and expected income.
- Farmers to keep an accurate record of financial transactions.
- To compare production practices within the farm itself and other farmers.
- To obtain credit loans from money lenders.
- In selecting the type of livestock to keep.
- To calculate the amount of tax that they have to pay.

TYPES OF FARM RECORDS

1. Inventory: This is a list of all properties or assets (things that can be converted into cash) that a farmer has on the farm. The best time to do this is at the end of the farming season when there is less work to do. The steps involved are

- Counting the items physically.
- Physical measurement e.g. land.
- Estimating the value using the present marketing prices.

NB: When estimating the present value of equipment, it is important to consider **depreciation** (loss of value of the item over time).

TYPES OF DEPRECIATION

A. Straight line depreciation e.g. an item bought at K20, 000.00 that is supposed to last 10 years. $K20, 000 - 10\% = K20, 000 - K2, 000 = K18, 000.00$

B. Fixed rate/declining balance depreciation:

$K20, 000 - K4, 000.00 = K16, 000.00$ and in year 2 the depreciation would be $K16, 000.00 - K3, 200.00 = K12, 800.00$.

2. Production records: They are used to record operations or activities and inputs used in producing a crop or raising an animal and the farm produce or outputs.

- A. Crop production records: This includes information of various crops grown by the farmer. This helps in establishing which crops are profitable.
- B. Livestock production records: This is a record of all animals purchased and sold on the farm, their breeding cycle and number of offsprings born and dead.
- 3. **Financial records:** These are kept for the farmer to know whether they are making profit or not.

TOPIC 17: ENTERPRISE COMBINATION

FACTORS AFFECTING ENTERPRISE COMBINATION

1. The availability of farming resources

- A. Land: If the land is small due to rapid population growth, it is difficult to combine enterprises.
- B. Labour: Farmers in tobacco enterprise need a lot of labour. If they are scarce, it can negatively affect enterprise combination.
- C. Capital: If there is sufficient capital, the farmer will find it easy to engage in enterprise combination.
- D. Managerial ability: This involves making sound decisions. Combination of enterprises will therefore depend on the farmer's knowledge of the enterprises involved.

2. The farmer's food requirements: The farmer has to reserve some maize for food as statistics indicate that:

- An adult will require an average of 300 kg of maize per year.
- A young person (under 18 years) will require 150 kg of maize.

3. Profitability of other enterprises: They need to select only those enterprises that will give them highest returns.

4. The nature of the enterprise

- A. *Competitive enterprise:* This is where an increase in one enterprise results in the decrease of the other as they compete for the same resources e.g. land, labour.
- B. *Supplementary enterprise:* This is where an increase in one does not affect the other, as they do not compete for resources and in other cases, one enterprise may benefit from the other e.g. g/nuts and maize.
- C. *Complementary enterprises:* This is when each contributes to the production of the other e.g. poultry and vegetable production.
- 5. **Opportunity cost:** This refers to the return that is given up e.g. raising animals instead of growing crops or reducing the amount of tobacco in preference to maize.
- 6. **Comparative advantage:** This means concentrating on enterprises that are best suited to the area in terms of soil, climate and nearness to the market.
- 7. **Risks and uncertainty:** A risk is the difference between what one expects and the actual outcome e.g. price fluctuation while uncertainty is a state of not knowing what will happen in future e.g. one can not tell whether there will be drought or not.

HOW FARMERS CAN SAFEGUARD THEMSELVES AGAINST RISKS AND UNCERTAINTIES

- * Selecting more reliable enterprises.
- * Crop diversification i.e. producing several crops.
- * Being flexible in method of production.
- * Practising input substitution e.g. using manure instead of chemical fertilisers.
- * Keeping food in reserves to ensure food security in bad seasons.

* Insuring the crops.

8. The farmer's abilities: Farmers need to be conversant with the techniques involved in the enterprise for them to make profit.

9. Change in prices and technology: When new technology is introduced, farmers need to evaluate its benefits before adopting it.

OTHER FACTORS

- i. The crop rotation to be practised
- ii. Expected yield from the enterprise,
- iii. Its input requirements.
- iv. Expected prices to be offered on the market.

TOPIC 18: FARM ENERGY

Energy is the ability or capacity to do work.

FORMS OF ENERGY

- | | |
|---------------|--------------|
| a. solar | h. wind |
| b. sound | i. potential |
| c. electrical | j. heat |
| d. fuel | k. chemical |
| e. light | l. water |
| f. mechanical | m. kinetic |

SOURCES OF ENERGY

- Solar energy is the source of all forms of energy.
- Light energy is transformed into chemical energy which later becomes mechanical energy
- Potential is the type of energy stored in matter.
- Kinetic energy is the one that makes objects move and is influenced by the mass and speed of the object.

SOURCES OF ENERGY AND THEIR USES

Source of energy	Uses
Solar	<ul style="list-style-type: none">• Manufacture of plant food• Drying of crop products
water	<ul style="list-style-type: none">• Producing electricity for domestic and industrial use
Fuel	<ul style="list-style-type: none">• Wood and charcoal for heating, cooking• Coal for heating and operating locomotives• Petrol and diesel for operating machines and running vehicles• Paraffin for heating, cooking and lighting
Biogas	<ul style="list-style-type: none">• For lighting and heating
Animal drought	<ul style="list-style-type: none">• For pulling implements and ox-carts used for transportation
Human power	<ul style="list-style-type: none">• Cultivation• Carrying out domestic and industrial work
Electricity	<ul style="list-style-type: none">• Lighting, heating, operating grinding mills, pumps for irrigation
wind	<ul style="list-style-type: none">• Driving windmills used for generating electricity and pumping water for irrigation
Mechanical power	<ul style="list-style-type: none">• Driving machines for both primary and secondary tillage

	operations
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KEEPING SAFE

- * Petroleum products should be handled with great care, as they are highly inflammable.
- * Running engines should be switched off when refuelling at pumping stations.
 - Do not wear loose clothes when working with machines.
- * Electric wires should be treated as live all the time to avoid being electrocuted.
- * Wear sun glasses when working in the sun.
- * Keep paraffin away from children.
- * Gases should be carefully handled since they are also highly inflammable.

TOPIC 19: IRRIGATION SYSTEMS AND DRAINAGE

CHARACTERISTICS OF DIFFERENT IRRIGATION SYSTEMS

System of irrigation	Characteristics
Furrow	<ul style="list-style-type: none"> • Water is led by gravity along furrows • There are channels between plots and rows of crops • The ground between the furrows is wet by the water from the furrows • The system needs a lot of water • It requires land which is sloping. • It is not economical in the use of water
Flood	<ul style="list-style-type: none"> • Requires a lot of water • Whole area is flooded • Requires heavy clay soils in which water penetrates slowly • Suitable for crops which can grow in standing water • The land needs to be level
Basin	<ul style="list-style-type: none"> • Where water is diverted to basins • Suitable for orchards and paddy rice
Drip	<ul style="list-style-type: none"> • Water is conveyed through plastic pipes which may be laid on or underground • The pipes have small holes • Uses water economically • Suitable for areas where water is scarce • The system may be risk if there are strong winds • The pipes may be blocked • Piping may be expensive • Can be used on sloping ground • Does not require much labour once established
Overhead/Sprinkler	<ul style="list-style-type: none"> • Does not require much labour once established • Can be used on most soils and land with varying slopes • Requires expensive equipment (pipes and sprinklers) • Most effective method of irrigation • There may be uneven distribution of water

FACTORS TO CONSIDER BEFORE CHOOSING AN IRRIGATION SYSTEM

- Amount and source of water available.
- Type and size of land to be irrigated.

- Labour required setting up and managing the system.
- Amount of capital required to set up the system.
- Topography (slope) of the land.
- Type of soil and its characteristics.
- Type and value of the crop to be grown.
- Demand for the crop.
- Your technical know-how of a particular system.

SETTING UP AN IRRIGATION SYSTEM

1. **Capital availability:** You need to know the amount of capital to set up the irrigation unit.
2. **Source and quality of water:** The source should be reliable and adequate. The water should also not contain any toxic (poisonous) substances.
3. **Type of land:** The land needs to be sloppy so that water flows easily. On the other hand, the land needs to be big enough.
4. **Type of soil and crop to be grown:** Some types require heavy soils.
5. **Maintenance:** You need to establish how you shall keep the equipment running all the time.

MANAGING AN IRRIGATION SYSTEM:

This Includes frequency and timing of watering and handling problems associated with irrigation.

FACTORS TO CONSIDER WHEN DECIDING ON HOW MUCH WATER TO APPLY

- Amount of rainfall: There is need to irrigate when there is insufficient rainfall.
- Amount of water applied during the previous irrigation: This is to avoid loss due to run-off.
- Crop requirements: The age and condition of the crop needs to be considered, as young plants require more water than older plants.
- Weather conditions: When conditions are humid, not much water is needed.
- Type of soil: Clay soil does not require frequent watering because infiltration is not as rapid as in sandy soil.
- The condition of the soil: The water should be applied so that the crops should not reach a wilting point (where plant roots are unable to absorb any little water available).

PROBLEMS ASSOCIATED WITH IRRIGATION AND THEIR SOLUTIONS

- Salt accumulation: These make the soil saline and most crops do not do well under such conditions. When sodium salts accumulate, they make the soil alkaline. This can be corrected by flooding salt-free water.
- Soil erosion: This occurs due to excessive application of water. This can be solved by ensuring that irrigation structures are properly maintained.
- Blockage of irrigation pipes.
- Water logging: This also results from applying too much water. It can be solved by controlling the amount and frequency of irrigation.

LAND DRAINAGE

This refers to the removal of excess water from the soil.

IMPORTANCE OF LAND DRAINAGE

- It reduces the input of water into the soil.
- To avoid waterlogging which is hazardous to most plant that requires little water.

- It improves soil aeration.
- It enhances microbial activity
- It warms up the soil which enhances seed germination.

EFFECTS OF WATERLOGGING

- > Poor aeration: This makes plant roots fail to transpire due to lack of oxygen.
- > Retarded microbial activity: It slows down the decay of organic matter because aerobic microbes are unable to respire.
- > The soil becomes cold and this slows down seed germination.

METHODS OF LAND DRAINAGE

1. **Surface drainage:** This removes excess water from natural rainfall and irrigation.
2. **Sub-surface drainage:** This is where ditches are constructed to carry the excess water by gravity to natural water way such as a stream.

DISADVANTAGES OF OPEN DITCHES ON A FARM

- They occupy land which would otherwise be used for crop production.
- They obstruct machinery where mechanisation is practised.
- They are more expensive to construct.

TOPIC 20: POPULATION GROWTH AND THE ENVIRONMENT

POPULATION GROWTH AND SOIL EROSION

Vegetation protects the soil from erosion because:

- Plant roots bind the soil, holding it firmly together.
- Leaves reduce the impact of raindrops, which would otherwise dislodge soil particles.
- Stems reduce the speed of run-off water so that such water flows slowly enough not to cause erosion.

HOW POPULATION GROWTH CAUSES DEFORESTATION

- The higher the population the greater the need for a settlement place hence clearing of land.
- Large population encourages the destruction of vegetation for the construction of infrastructure e.g. shops.
- The higher the population, the greater the demand for forest products like timber.
- The higher the population the greater the need for clearing forests to open new farms.
- More animals may be raised which eventually leads to overgrazing.

THE EFFECTS OF SOIL EROSION

- Loss of fertile top soil which contains humus and nutrients. This leads to production of low yields.
- Reduction in arable hectareage: It results in gullies, rills which reduces the amount of land available for arable cropping.
- Food insecurity: Low food production may be due to loss of top soil.
- Exposure of plant roots: This increases root lodging and decreases the capacity of roots to absorb nutrients.
- Pollution of water reservoirs: This might happen due to substances like fertilisers and pesticides, which are carried by run-off water.
- Silting of water reservoirs: Soils which are carried away are deposited in rivers, lakes or dams.

- Flooding: When soil erosion results in silting, the reservoirs can sometimes fail to accommodate much water which leads to erosion.
- Transmission of soil pests and diseases.
- Depletion of water resources: Low infiltration reduces the amount of ground water which results in drying up of wells.

WAYS OF CONSERVING WATER

1. Dams: These are water reservoirs that are usually built across a river to catch or hold water.
2. Contour ridges: These are ridges constructed across the slope so that they trap and hold water allowing it to sink into the soil.
3. Contour bunds: These are broad-based ridges constructed across the slope.

THE IMPORTANCE OF CONSERVING WATER

- Domestic use: For bathing, washing, drinking and cooking at home.
- Crop production: Plants need water for germination, photosynthesis, transpiration and dissolving mineral salts.
- Hydro-electric power: When water is insufficient, power supply becomes erratic.
- Livestock use: Farm animals need to drink water everyday.

TOPIC 21: POPULATION GROWTH AND FOOD SECURITY

- * **Food security** refers to a situation where there is enough food for everyone at all times.
- * **Food sufficiency** means the ability to produce one's own food in adequate quantities without depending on external supplies.

WAYS OF ACHIEVING FOOD SUFFICIENCY

- * Improved farming technology: This means new, better and scientific methods of growing crops and raising livestock. It can improve food production through:
 - * Enabling timely completion of critical farm operations.
 - * Developing more effective pesticides, fungicides and herbicides and more efficient ways of applying them.
 - * Enriching soil fertility through the development and proper use of better fertilisers.
 - * Developing and using better irrigation systems e.g. drip and sprinkler.
 - * Improved seeds: this e being bred for disease resistance, fast growth, early maturity and high yield.
 - * Good land husbandry: This involves using each piece of land according to its capability.
 - * Fair land policies: A fair land policy should encourage equitable land distribution.
 - * Good crop husbandry: This includes early land preparation, early planting, timely weeding correct fertiliser application and pest and disease control.
 - * Irrigating crops: This ensures that farmers obtain high yields even in times of drought.
 - * Good livestock husbandry: This includes proper housing and medication of farm animals to ensure high productivity.
 - * Fair pricing policies.
 - * Crop diversification: This means growing more than one crop within the same growing season.
 - * Mixed cropping: This involves growing crops and raising animals on the same farm
 - * Encouraging estate food production: Estates can increase food production by:
 - * Allocating more land and other resources to food crop production.
 - * Training farmers in food crop production.
 - * Providing tenants with farm inputs for food crop production as short-term loans.
 - * Food storage: This is important by:

- * Reducing spoilage
- * Ensuring availability of food throughout the year.

TOPIC 22: AGRICULTURAL DEVELOPMENT SERVICES

Land husbandry services: These aim at promoting sustainable use of land resources for agricultural production. These services include:

- Guiding and creating awareness among farmers and the general public about the scarcity and vulnerability of land resources in the country.
- Providing relevant information, knowledge and skills in all aspects of land use and environmental conservation.
- Encouraging and helping farmers to construct and establish physical and biological soil conservation structures.

These services are provided by the

- Land Resource and Conservation unit.
- Agricultural Extension staff off all the ADDs.
- Land Husbandry Training Centre in Zomba.
- Environmental Education Unit in Lilongwe.

Irrigation: This service is provided by the Department of Irrigation which has established sprinkler irrigation and treadle pumps.

Farm settlement: Some people are being settled in areas where fertile arable land with a favourable agricultural climate exists. The aims of farm settlement are to:

- (a) Promote special crops such as cotton and tobacco.
- (b) Promote the participation of women in agricultural development.
- (c) Encourage handicapped people especially the blind to contribute towards agricultural development.
- (d) Improve the spreading of improved agricultural practices to neighbouring rural communities.

Farm mechanisation: Its services involve:

- Training farmers in the selection, care and management of draught animals.
- Training draught animals in ploughing, ridging and cultivating.
- Introducing and supplying alternative sources of draught animals such as donkeys.
- Improving the availability of both hand-operated and animal powered machinery for farmers to buy through credit.
- Testing and releasing small-scale machines such as water pumps. NB: These NB: These services are provided by Ox-training unit.

Seed technology: This is the provision of good quality seeds for improved crop varieties to smallholder farmers. Certified seeds can be obtained from

- ADMARC
- National Seed Company of Malawi.
- Lever Brothers Ltd.
- Pannar Seed co. Ltd.

Crop protection: Its main objective is to minimise crop losses due to pests, diseases or weeds. Services which ensure this are:

- Breeding and releasing resistant crop varieties by the Department of Agricultural Research.

- Establishing plant quarantines and other government control measures.
- Plant pest diagnostic and advisory services provided by the Department of Agricultural Research.
- Recommending the use of specific pesticides supplied by ADMARC.

Provision of farm inputs: This aims at encouraging farmers to use recommended inputs. The main distributors are

- Agora,
- Agricultural Trading Company (ATC),
- OPTICHEM and Farmers' World.

Soil testing: This service is provided by Bvumbwe and Chitedze Agricultural Research Stations. they have laboratories for analysing the soil inorder to make fertiliser recommendations.

Agricultural credit to smallholder farmers: To facilitate this, government established the Malawi Rural Finance Company (MRFC) located in every Agricultural Extension Planning Area (EPA).

Farm management: This ensures the effective use of available resources, appropriate combination of enterprises and proper farm planning.

Food nutrition: This has been established by the Ministry of Agriculture with the aim of:

- Helping smallholder in ensuring food security.
- Establishing systems for assessing household food security and early prediction of shortfalls.
- Monitoring food and nutrition situations in EPAs, RDPs and ADDs.

Extension and training: Its aim is to offer technical information to smallholder farmers. This is provided by the Agriculture Communications Branch.

TOPIC 23: GENDER AND AGRICULTURAL DEVELOPMENT

CAUSES OF GENDER BIASES IN AGRICULTURAL TECHNOLOGY

1. Lack of early socialisation to technology: In Malawi, boys are exposed to technological innovations early in their lives as compared to girls and this prepares the boys to deal with the technology in future.
2. Lack of technological information: Men are favoured in acquisition of information in the following ways:
 - Our culture gives free mobility to girls and not boys as a result, boys can seek information from many sources.
 - Most parents see the benefits of education as favouring boys than girls and are ready to render more support to the boys.
 - Most of the agricultural extension workers are males hence easy to make contacts with their fellow males.
3. Lack of access to capital: Culturally, males assume control over capital items and this makes it easy for them to buy technological items.
4. Discriminatory attitudes and gender stereotypes: Malawian society is generally biased towards females in the use of various technologies e.g. it is strange to see a woman driving a tractor.

5. Lack of confidence: Most females are not confident to use the technological equipment mostly because they have not been in contact with them in the early days.
6. Lack of exposure to role models: There are few older women in technologically challenging positions who young female farmers can copy.

IMPLICATIONS OF GENDER BIAS FOR AGRICULTURAL DEVELOPMENT

- Low agricultural productivity: Since most women do not use the technology, their farm output is reduced as farm operations fail to be completed in time.
- Food insecurity, starvation and low energy output: Due to low yields, there may be food insecurity and the family will suffer from hunger and malnutrition. Farmers will be weak and lack the energy for farm work.

FORM FOUR

TOPIC 1: SOIL DEGRADATION

Soil degradation refers to a loss in the value and quality of the soil mainly caused by erosion (taking away of top soil either by running water or wind) or human activities like poor agricultural operations e.g. cultivating along the slopes.

TYPES OF EROSION

1. WATER EROSION: This is where water drops detach soil particles. It is divided into:

- Splash -Rill
- Gully
- Sheet

2. WIND EROSION: This is where unprotected soil which has been dried by the sun is blown away.

3. PHYSICAL EROSION: This takes place when the structure of the soil is destroyed by machines leading to the soil becoming compacted or puddled hence also known as **puddle erosion**.

CAUSES OF SOIL DEGRADATION

- Cultivating along steep slopes and river banks makes the top soil which is fertile to be washed away.
- Constructing ridges along the slopes also washes away the top soil as water fails to get trapped.
- Continuous cropping exhausts the soil.
- Cultivating the soil when it is too dry or too wet damages its structure.
- Deforestation makes the land bare and exposed to erosion which blows away the fertile top soil.
- Uncontrolled fire destroys vegetation which protects the soil and also destroys organic matter.
- Overgrazing also exposes the soil to erosion.
- High human population creates need for land for settlement and food leading to cultivation in marginal areas (places not suitable for cultivation).

EFFECTS OF SOIL DEGRADATION

- Loss of top soil resulting into reduced yields.
- Reduced infiltration (penetration of water into the soil) and increased run - off.
- Silting of water reservoirs due to sedimentation (accumulation of soil particles and other wastes at the bottom of water reservoirs).

- Polluting of water resources.
- Low ground water - table due to increased run - off.
- Increased incidences of flooding.
- Loss of arable land due to gullies that are formed.
- Loss of grazing land.

CONTROL OF SOIL DEGRADATION

1. PHYSICAL

- Constructing storm drains which divert water into natural water ways.
- Constructing tie or box ridges which allow water to sink into the soil.
- Constructing contour bunds (ridges which are constructed across the slope following contour lines).

2 BIOLOGICAL

- Maintaining soil cover by planting trees and grasses.
- Planting close - growing crops e.g. groundnuts.
- Afforestation (planting large number of trees on bare ground).
- Practising Agro forestry (planting of crops and trees on the same piece of land).
- Practising crop rotation (changing of growing crops on the same piece of land year after year).
- Adding farm yard manure which improves soil structure.
- Controlling bush fire by making fire breaks.
- Reducing the stocking rate (the number of animals per unit area)
- Practising rotational grazing to avoid overgrazing.
- Practising family planning to control human population.

TOPIC 2: CROP IMPROVEMENT

Crop improvement means increasing the productivity of cultivated plants by developing better cultivars (cultivated varieties) which possess superior characteristics.

NB: There are inheritable (genetic) differences between plants hence the superior characteristics of the better plants have to be passed on to the next generation of plants.

AIMS AND OBJECTIVES OF CROP IMPROVEMENT

1. To increase the average crop yield (yield quantity). Objectives related to this are:

- > To increase the biomass (capacity to produce and retain adequate quantity).
- > To improve partition (capacity to divert biomass to desired portion of the plant) e.g. in mangoes, the biomass may be directed to the fruit.
- > To increase pest and disease resistance.
- > To increase seasonal adaptation i.e. matching (adapting) the growth and maturity of the crop to the length of the growing season.
- > To increase tolerance to adverse environmental conditions e.g. Drought. Water logging.

2. To improve the quality of the crop (yield quality).

Objectives related to this are:

- To achieve uniformity (having same characteristics) in terms of germination time, fruit size, shape, colour.
- To increase the nutritive value of crop products.
- To promote dwarfness (shortness) as it makes harvesting quicker.

- To improve processing qualities of crop products as required by processors in the industries.
- To increase the market value of crop products by developing crops of better colour and taste (palatability) as demanded by the consumer (buyer).

METHODS OF CROP IMPROVEMENT

1. INTRODUCTION: This is the importation of crop varieties with superior characteristics to serve as foundation for breeding or propagation.

NB: For successful growth, environmental conditions must be similar to those of the country of origin e.g. maize variety Ukiruguru Composite A (UCA) was imported from Tanzania and introduced to high altitude areas of Shire Highlands, Namwera and Lilongwe plains while groundnut variety Malimba was brought from Gambia and introduced to Shire valley.

2. SELECTION: This means choosing of superior plants that have desirable characteristics for breeding. However, this does not add any new desirable characteristics to a crop as it only adapts characteristics from the parent material.

METHODS OF SELECTION

A. MASS SELECTION: This means choosing a large number of plants showing desirable characteristics. In this case, plants without desirable characteristics fail to survive and die.

B. SINGLE PLANT SELECTION: This means choosing individual plants for breeding.

3. HYBRIDISATION: This means cross- breeding. Three steps are necessary for this:

A. Choosing parents:

- A crop that is high yielding but easily gets attacked by diseases must be crossed with a low yielding but disease resistant crop.
- A high yielder that is tall growing must be crossed with a low yielding dwarf.
- A late maturing high yielder to be crossed with an early maturing low yielder.

B. Self- pollinating the parental lines:

The chosen parents are self- mated or mated with close relatives for 5 - 6 generations. This is also called **inbreeding**. However, it reduces plant vigour and this is called **inbreeding depression**.

C. Crossing the pure lines: This is whereby pollen from the inbred (pure) line is transferred to the stigma of the flower of the other inbred plant. These results in increased plant vigour called **hybrid vigour** or **heterosis**. *NB:* To prevent accidental self- pollination, male parts (anthers) are removed before maturity. This is called **emasculation**.

TOPIC 3: IMPORTANCE AND TYPES OF PASTURE

Pasture is grass and/or other herbaceous plants grown and used as animal feed.

IMPORTANCE OF PASTURE

- It improves and maintains soil fertility by (a) enabling the circulation of nutrients through the animal and back into the soil via dung and urine, (b) It helps to make nitrogen available to plants in a process called nitrogen fixation
- It improves soil structure since the decayed plant materials increase the organic matter content of the soil.
- Pasture controls soil erosion by the vegetative growths which covers the soil and protect it from erosion.
- The soil cover reduces run - off and increases infiltration.

- The fibrous roots of the plants bind the soil.

TYPES OF PASTURE

1. **NATURAL:** This is uncultivated grassland in which indigenous species are mostly found e.g. thatching grass.
2. **CULTIVATED**

A PERMANENT: This contains at least one introduced (improved) species of grass or legumes that is managed for 10-15 years e.g. star grass, torpedo grass.

B. TEMPORARY (LEYS): Cultivated pastures usually lasting 3-5 years. They may contain a pure stand of grass or legume or a combination e.g. Rhodes grass, Napier grass, Guinea grass.

IMPORTANCE OF CULTIVATED /IMPROVED PASTURES

- (a) They give high dry matter yield than natural pastures.
- (b) Legumes can be included in the cultivated pastures and this has the following benefits:
 - The combined yield is higher than in pure stand.
 - The nitrates fixed by the legumes are used by the grass to increase yields.
 - Legumes have higher digestibility even when mature.
 - Legumes retain high nutritive value even when mature.
- (c) Cultivated pastures especially legumes have higher protein content.
- (d) Improved pastures retain their juvenile (youth) stage much longer hence higher digestibility.

METHODS OF ESTABLISHING PASTURE

1. BROADCASTING: This is where pasture is spread on the soil surface either by hand or a fertiliser spreader and is then raked into the soil.

ADVANTAGES

- It is the easiest way of sowing since no skill is required.
- It is time - saving.

DISADVANTAGES

- Some seeds on the surface can be washed away by water or picked by birds.
- Some seeds may be buried too deep and fail to germinate while those on the surface may not receive moisture enough to germinate.
- There may be too many seeds in some places resulting into overcrowding of plants.
- It is expensive since it requires a lot of seeds.
- It is difficult to weed and apply fertiliser.

2. DRILLING: This is where pasture is sown in trenches (drills) made by sticks, hoes or machinery and covered by soil. Mechanically, **Planet Junior Seed Drills** are used.

ADVANTAGES

- It is more efficient than broadcasting since seeds are placed at the desired depth and adequately covered.
- Fertiliser can be applied more efficiently.

DISADVANTAGES

- It is time - consuming if done manually.
- It is expensive if done mechanically.

3. OVERSOWING: This is sowing of pasture into an already established pasture or natural pasture. It is also known as **sod seeding**.

ADVANTAGES

- > The plants assume the age of the parent plant so plants mature early.
 - > It reduces the problem of dormancy (inactiveness).
 - > It ensures genetic uniformity as the offsprings will resemble their parents.
 - > It is the only way of propagating crops whose seeds are not viable e.g. bananas.
 - > Vegetative organs are harder than seedlings hence able to withstand environmental hazards e.g. drought.
 - > Vegetative organs have generally sufficient food reserves to help the young shoots to become established.
- Planting materials are readily available from the previous crop.

PASTURE ESTABLISHMENT PROCEDURE

- Time of sowing: This should be done early in the rainy season i.e. end of January.
- Land preparation: This involves clearing the land and breaking large clods of soil.
- Selecting pasture seed: Seed quality is expressed as the **Pure Line Seed Content (PLSC)** and can be calculated as follows:

$$\text{PLSC} = \frac{\text{Purity \%} \times \text{Germination \%}}{100}$$

NB: Certified pasture seeds which are free of trash, weeds and diseases are recommended for use.

- Selecting appropriate grasses and legumes: The following criteria should be used:
 - Adaptability to the environment.
 - They must be capable of producing high levels of yield per hectare and respond positively to improved management e.g. fertiliser application.
 - They must have a high crude protein content even in dry season.
 - Proposed duration of the pasture: whether the pasture is permanent or temporary.
 - Compatibility with desired species i.e. the grasses should grow together with other chosen species.
 - Proposed method of utilisation of the pasture i.e. whether they will be used for grazing, hay or silage.
 - Continued digestibility of the grasses i.e. legumes must remain green and continue to be palatable and highly digestible.
 - Resistance to pests and diseases e.g. strato grass is resistant to nematodes.
 - High tolerance of water - logged conditions e.g. dambos.
 - Role of the pasture in the rotation e.g. if it is to control eelworms in the rotation, appropriate varieties should be chosen.

CALCULATING THE SEEDRATE

Seed rate is the weight (amount) of seed required per hectare (expressed as kg/hectare).

$$\text{Seed rate} = \frac{\text{expected plant population/ha}}{\text{seed size} \times \text{purity \%} \times \text{germination \%}}$$

Example

Seed size	=	300,000 seeds/ha
Purity %	=	80%
Germination %	=	30%
Expected plant population	=	900,000 plants

$$\text{Seed rate} = \frac{900.000 \times 1 \text{ kg} \times 100 \times 100}{1 \text{ ha} \times 300,000 \times 30 \times 80}$$

Answer = **12.Skg,ha**

FACTORS AFFECTING SEEDRATE OF PASTURES

- * **Purity of the soil:** If the soil is mixed with weeds, it will require more seeds to achieve the desired population.
- * **Germination percentage:** The higher the germination percentage, the lower the Seed rate required.
Seed size: Small - seeded species are sown at lower seed rates since there are more seeds per kilogram.
- * **Pure or mixed stand:** Where grass/ legume mixtures are to be established, the seed for each is reduced.
- * **Soil filth:** If the seedbed is well prepared, the seed rate can be reduced since the germination percentage is likely to be higher.
- * **Growth habit of the species:** Grass and legumes with large vegetative growth require lower seed rates to reduce shading.
- * **Method of sowing:** Broadcasting requires higher seed rates because they result in reduced survival of seedlings.

SEED TREATMENT FOR PASTURES

Seed treatment is the processing / handling of planting materials (seeds) in order to improve germination and/or promote successful establishment. The following are treatment methods:

1. **Hulling:** This is the removal of the pod from around the seed e.g. cook stylo, silver leaf. This has the following advantages:
 - It increases the rate of germination.
 - It makes the **pelleting** (putting a thin layer of material around the seed to improve establishment) to be easy.
2. **Scarification:** This is the process in which the hard testa (seed coat) of some legumes are softened in order to speed up germination. This can be done mechanically (by scratching the testa using machines) or by using hot water.
3. **Inoculation:** This is the process of mixing legume seed with the correct type of rhizobium bacteria before sowing for successful nodulation and nitrogen fixation.

FERTILIZER APPLICATION

Pure stand: 200 kg/ha of 20:20:0 and 110 kg/ha of super phosphate.

Mixed stand: 80kg/ha of CAN and 220 kg/ha of super phosphate

PASTURE MANAGEMENT AND UTILISATION

FERTILISER APPLICATION

- a. At the beginning of the rainy season, 23:21:0+ 4s should be applied.
- b. After each cut or grazing, CAN is recommended.

- c. Superphosphate is needed for legumes at the start of the rainy season to promote nodule formation.
- d. Potassium is applied to 'cut and carry' pastures.

CONTROLLING WEEDS

- i. Weeds in broadcasted pastures can be controlled by hand - weeding,
- ii. In forage crops, weeding can be done mechanically especially if they are in rows,
- iii. Broad - leaved weeds can be controlled by spraying herbicides like 2.4.D.

CONTROLLING PESTS AND DISEASES

- Army worms and elegant grasshoppers can be controlled by spraying **carbaryl**.
- Termites can be controlled by spraying **dieldrin**.
- Aphids can be controlled by spraying **Malathion**.

NB: Pasture that has been sprayed should be left for 7 - 10 days without grazing.

- Diseases can be controlled by rogueing off (removing or uprooting) infected plants.

GRAZING MANAGEMENT

- Controlling stocking rates: Stocking rate is the number of animals per unit area. Overstocking leads to overgrazing while understocking leads to wastage of pasture and selective grazing of delicious species.
- Matching grazing pasture to carrying capacity: This refers to the maximum number of animals per specified type of feed.
- Providing sufficient grazing intervals (rest periods): It must be long enough to allow pastures to recover but not too long to prevent the grass from becoming difficult to digest.

SYSTEMS OF GRAZING

1. ROTATIONAL GRAZING: This is the system in which 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 recovery.

ADVANTAGES

- It provides enough resting time for pasture to recover.
- It ensures that very palatable species are not grazed out.
- It controls soil erosion since overgrazing is avoided.
- It ensures that sufficient feed is available throughout the year.
- It controls ticks and internal parasites like roundworms since movement into the paddocks breaks their life cycle.
- Dung and urine are distributed to all parts of pasture for increased fertility.

DISADVANTAGE

- It requires a lot of capital for fencing and watering.

2. STRIP GRAZING: This is where animals are confined to a very small fenced strip of pasture for a day or two and forced to eat all the herbage present before being moved to another strip. It involves use of an electric wire.

ADVANTAGES

- * It allows pasture to be used completely.
- * It allows availability of high quality pasture each day.

DISADVANTAGE

It is expensive to fence the small strips.

3. ZERO GRAZING/ STALL FEEDING/ CUT AND CARRY

This is where is cut daily and transported to the stalls to feed the animals.

ADVANTAGES

- > It ensures 100% utilisation of pasture since all that is cut is eaten.
- > It avoids trampling of grass by livestock since animals are not moved onto the pasture.
- > It prevents animals from feeding selectively on only the most palatable pasture
- > Disease spread is avoided since animals do not move out to look for pasture.
- ^ It eliminates the risk of overgrazing.
- > It requires less capital since fencing of pasture is not done.

DISADVANTAGE

- > It requires a lot of labour to carry the pasture to the pens (stalls).

4. CONTINUOUS GRAZING: The system in which animals are placed on a pasture field for prolonged periods without allowing the pasture to rest.

ADVANTAGES

- It is cheap since it does not require fencing.
- It does not require moving the animals from one paddock to the other.
- It encourages the build up of parasites.
- It does not give the pasture time to recover.
- It leads to overgrazing.

5. DEFERRED GRAZING: This is the system where the pasture is grazed during dry season only while in the wet season the pasture is allowed to mature.

ADVANTAGE

- It ensures the availability of some feed during the dry season.

DISADVANTAGE

It allows herbage to become mature, fibrous less digestible and less nutritious.

BURNING PASTURES

ADVANTAGES

- It removes the dry inedible herbage at the end of the dry season.
- It prevents woody species from taking over the pasture by burning them off.
- It controls pests and diseases by burning them off.

DISADVANTAGES

- It may destroy the legume content of the pasture.
- It may reduce sward vigour if the roots are burnt as well.

PASTURE CONSERVATION

HAY: This is herbage that is cut and preserved by partially drying it for future use. Varieties such as silver leaf, Rhodes grass are suitable for this.

IMPORTANCE OF HAY

- It can be kept for a long time without loss in nutritive value.
- It is the cheapest source of animal feed.
- It supplies most of the energy, vitamins and minerals in the dry season.
- It can be sold for cash. -.

HAY MAKING PROCESSES

A. Cutting: This should be done before the plants flower to obtain a nutritious and palatable product.

B. Drying: It should be partially dried for about 3 days to a moisture content of 20%. Overdrying reduces the carotene content (vitamin A)

C. Stacking: This is the compressing of the partially - dried grass in a shade with a leak - proof roof.

FACTORS AFFECTING HAY QUALITY

- (a) Pasture species: It should contain more legumes than grass to provide proteins, palatability and digestibility.
- (b) Stage of growth at cutting: Mature and old pastures are more fibrous.
- (c) Degree of drying: Hay with high moisture content develops moulds.
- (d) Presence of foreign materials, weeds, poisonous plants and other foreign materials like wire will lower the quality of the hay.
- (e) Weather at the time of harvesting and drying: Rainy weather lengthens the period of drying.
- (f) Storage: Wet or leaking storage facilities lower the nutritive value.

SILAGE: This is green forage that is preserved by fermentation.

ADVANTAGES OF SILAGE

- It makes use of a wide variety of forages including those that can not be made into hay. e.g. maize, napier.
- It maintains succulent (juicy) state of the green fresh forage.
- It preserves higher percentage of protein than hay.
- Less vitamin A is lost than in sun - cured hay.
- It can be kept for a long time if it is better preserved.

DISADVANTAGES

- It is more expensive than hay.
- Its moisture content is high which reduces-amount of dry matter available.

SILAGE MAKING PROCESSES

- Cutting: This should be done before flowering or at podding stage.
- Partial - drying: It must be done to moisture content of 65% so that it maintains succulence.
- Chopping: It must be cut into shorter lengths to help in compression.
- Stacking: This is done as quickly and tightly to eliminate air.
- Compressing: This is done to push out oxygen. Plastic sheeting can be used to make it air - tight.
- Fermentation: This is done by anaerobic bacteria which produce a lot of heat.

FACTORS AFFECTNG SILAGE QUALITY

- Type of plant material used.

- Availability of carbohydrates to provide energy to bacteria.
- Additives placed in the silo.
- Speed of filling the silo.
- Tightness of the air seal.
- Amount of protein broken down during fermentation.
- Water content of the herbage.
- Age of the crop used.

FOGGAGE: This is standing hay left ungrazed in readiness for the dry season.

ADVANTAGE

- It is a cheap method of preserving feed.

DISADVANTAGE

It reduces feed quality since it is mature.

FACTORS AFFECTING FOGGAGE QUALITY

- > Pasture species used.
- > Digestibility.
- > Palatability.
- > Ratio of legumes.
- > Crude protein content.
- > Regenerative ability (ability to regrow).
- > Persistence of the species i.e. ability to continue growing and looking fresh.
- > Wet - site tolerance: ability to grow in water - logged areas.
- > Drought tolerance.
- > Toxicity level (amount of poison).
- > Soil fertility/ amount of fertiliser applied.

TOPIC 4: CROP PROCESSING AND STORAGE

1. MAIZE

- (a) Stripping the maize cob sheath: This involves removing the husks (covers) thereby exposing the grain to air faster.
- (b) It also makes pesticides reach the grain easily.
- (c) Shelling the grain: This involves removing the grain from the cob. It speeds up drying and reduces the storage space.
- (d) Drying the grain: Maize can be sun - dried (spread on the mats, concrete floors) or air - dried. Drying is important because:

It prevents moulds from developing on the pericarp/ testa.

It makes the testa strong enough to resist some pests.

It reduces the respiration rate in the grain.

It prevents sprouting (germination) of the grain while in storage.

- (e) Cleaning: This can be done by winnowing to remove the chaff.

- (f) Storage: - shelled maize can be stored in tins, baskets, drums, sacks
- Unshelled maize can be stored in granaries.

CONDITIONS OF THE GRAIN STORES

i. Dry: They must be leak proof and dry to prevent moulds

ii. Cool: It must be kept out of the sun to prevent heating which increases its respiration rate

- iii Clean: This is necessary to prevent the multiplication of pests and pathogens (disease-causing organisms)
- iv. Air - tight: It must have no holes or cracks to keep out insect pests.

2. GROUNDNUTS

- It can be stored in pods (unshelled) or shelled but dry in both cases
- Shelled groundnuts require cleaning and drying before being stored either in nkhekwe (unshelled) or sacks (shelled)

3. SWEET POTATOES

- (a) Cleaning: Dirt should be removed from the tubers to prevent insects, fungi from being taken into storage places.
- (b) Selection: Only tubers that are free from bruises, cuts or any damage should be chosen for storage.
- (c) Curing: The tubers should be spread on a cool dry place for about 5 days to make the skin thicker for easy storage. It also promotes healing of the cuts in the tubers.
- (d) Piling: A soft bed (layer) of grass or banana leaves should be put on the floor to cushion them.
- (e) Storing: Ventilation in the storage place is necessary to prevent build up of moisture.

4. CASSAVA

This is best stored in processed form to reduce toxicity (poisonous content of the tubers and also improve palatability and length of the storage before going bad. Dry pieces (Makaka) can be stored in sacks.

5. MANGOES

- It is also best stored in processed form as chutney, juice which is bottled or caned. Fresh mangoes can be stored for short periods using the following procedures:
- Wiping off any latex to prevent damage, damage of the fruit's skin
- Selection of fruits that are unbruised.
- Disinfecting the fruits to prevent multiplication of fruit flies.

TOPIC 5: THE REPRODUCTIVE SYSTEM OF CATTLE

REPRODUCTIVE ORGANS OF A BULL (MALE CATTLE)

- Testicles / Testes: These are contained in a sac called scrotum suspended between the hind legs. This is where sperm are produced.
- Epididymis: These are small coiled tubes that surround the testes>-
- Sperm Ducts / Vas deferentia: They carry sperms from the testicles to the seminal vesicles (part of the accessory glands).
- Accessory glands: They comprise the prostate gland, cowper's gland and seminal vesicles. Their function is to produce a sticky fluid called semen.
- Urethra: A tube that leads from the bladder through the penis. It also allows semen (a fluid which contains sperms) to pass through as the penis is being introduced into the vagina of the cow during mating. The sperms are released by the bull during a process called **ejaculation**.
- Penis: This is an organ used for mating. It is spongy and gets filled with blood as the bull mates with the cow.

REPRODUCTIVE ORGANS OF A COW (FEMALE CATTLE)

- Ovaries: Their function is to produce eggs (ova). They also secrete hormones; oestrogen and progesterone.
- Oviducts: These assist in the movement of the eggs in the uterus.

Uterus: This is the womb where the embryo grows and develops into a young animal.

- Cervix: This is a thick wall of muscles which separates the uterus from the vagina.
- Vagina: This receives the bull's penis during coition (mating). It also serves as a birth canal and a passage for urine from the bladder.

Vulva: This is the external opening of the genital organs. Reproductive process in cattle

- It starts with mating of male and female animals.
- Through the mating, the egg cells from the female are fused with the sperms from the male which results in the formation of the embryo (zygote).
- Cattle are **viviparous** (animals which bear live young ones).

PUBERTY

- Reproduction can take place as soon as the male and the female reach sexual maturity. This is called **puberty**.
- In bulls, sperm production starts while in females development of the ova, heat period, ovulation and uterus starts.
- In bulls, a hormone called **testosterone** which brings about development of the sperm, accessory organs and the desire to mate starts.
- In cows, the hormone **oestrogen** activates egg development, ovulation (release of eggs) start.
- Bulls reach puberty at 8 months while heifers (young females) take 9 months.

FACTORS WHICH CAN HASTEN PUBERTY IN ANIMALS

- * Environmental factors: unfavourable conditions like drought can delay puberty.
- * General management: poor feeding can also delay puberty-
- * Type and breed of animal: some animals mature more quickly than others.

OESTRUS: This refers to **heat period** (when female animals show the desire to mate).

SIGNS OF HEAT IN A COW

- It becomes restless.
- Frequent bellowing (mooing)
- Mounting other animals and standing still when mounted by other cows.
- Mucus discharge from the vulva.
- Increase in urination.
- Decline of milk production in lactating cows.

The oestrus cycle has the following four stages:

A. Proestrus: This can last up to 3 days during which the reproductive tract is prepared, follicles grow, development of the ovary starts, thickening of the vaginal walls and swelling of the vulva.

B. Oestrus: This is the stage when the animal has strong sexual desire.

C. Metoestrus: The stage when the **corpus luteum** (a sack to contain the egg) is formed, a hormone called progesterone which suppresses the growth of follicles so that no more eggs are released is also formed.

D. Dioestrus: This is the retention of the corpus luteum making the animal pregnant.

GESTATION PERIOD: This is the period from the time of fertilisation to birth of the young one. In cattle, it takes 283 days.

After fertilisation, the zygote attaches itself to the walls of the uterus and this is called **implantation**.

FOETUS DEVELOPMENT

- The embryo undergoes a series of cell divisions resulting in the formation of tissue organs.
- The first organ to be formed is the heart accompanied by the circulatory system then the **placenta** (attachment to the lining of the uterus).
- The foetus is surrounded by three fluid - filled membranes which cushion and protect it, keep it warm and serve as lubricants when the cow is giving birth. These are **amnion water sac**, the **chorion** (which surrounds the amnion) and the **allantois** (which is formed as the urinary bladder develops).

FEEDING: The foetus gets nutrients from the mother and these diffuse through the blood of the mother. This is facilitated by finger - like structures called **villi**.

RESPIRATION: It is divided into two stages:

I. Oxygen is taken in and carbon dioxide is released.

II. Oxygen breaks down food nutrients (fats and carbohydrates) through **oxidation**. During this process, carbon dioxide, water and energy are released.

EXCRETION: Waste products such as urea and carbon dioxide are eliminated by diffusion from its blood system back into the mother's blood.

PARTURITION: This is the process that takes place when the animal gives birth to its young one. The cow will show the following signs that it is ready to give birth:

- It becomes restless and looks for a quiet place.
- The udder becomes large.
- There is mucus discharge from the vagina.
- Pelvic ligaments relax and become soft.

NB: At the beginning of labour:

- Walls of the uterus begin to contract.
- Amniotic membranes that surround the calf and that are filled with fluid break as a result of the contraction.
- As the pressure of the amniotic fluid increases, the cervix dilates (opens wider).
- The calf will then be pushed with front feet first. This is called **normal presentation**.
- If the calf is born with tail first, this is called **breech presentation** or **dystocia**.

MILK PRODUCTION

- > Cows have four mammary glands (quarters) which are surrounded by cells called **basket cells**.
- > There are also **alveoli** responsible for manufacturing and secreting milk which passes through small ducts to the large ducts.
- > It then goes to the **gland cistern** then **teat cistern**. The milk is then finally ejected through the **streak** or **teat canal**.

TOPIC 6: REPRODUCTIVE SYSTEM IN POULTRY

REPRODUCTIVE ORGANS OF A COCK

- It has two testicles which lie high up in the abdominal cavity.
- Each testis is connected to a **cloaca** (vent) by the **vas deferens** (sperm duct).
- There are also structures called **papillae** which are copulating (mating) organs).

REPRODUCTIVE ORGANS OF A HEN

It has an oviduct which performs the following functions:

- Infundibulum: This is where fertilisation of eggs takes place. Sperms are also stored there after mating with a cock.
- Magnum: This is where albumen is added.
- Isthmus: Egg membranes, mineral salts and water are added.
- Uterus (shell gland): This is where the shell is added and it takes 18-21 hours.
- Vagina: This is where pores in the egg are sealed.
- Cloaca: It is through this part that eggs are passed out (oviposited)

TOPIC 7: LIVESTOCK IMPROVEMENT

This refers to the attempt to improve the genetic make - up of livestock and the environment in which they are kept.

- Characteristics that an offspring has are passed on from parents during fertilisation.
- Hereditary materials (genes) are carried by chromosomes which are contained in the nucleus of animal cells.

AIMS OF LIVESTOCK IMPROVEMENT

- To increase the yields of milk, meat and eggs.
- To improve the quality of animal products e.g. butter fat content I milk, quality of wool.
- To increase disease resistance in animals.
- To breed animals that are resistant to climatic conditions.
- To improve growth rate (shorter time to reach maturity).

METHODS OF LIVESTOCK IMPROVEMENT

1. Selection: It means choosing animals with desirable characteristics for breeding. This is based on appearance (phenotype) and desirable characteristics (genotype).

- Selection of males based on performance of their offsprings is called **progeny testing**.
- Selection of females based on characteristics such as egg or milk production is called **sib selection**.
- Selection of both males and females based on desirable characteristics is called **artificial selection**.
- Selection of animals based on the environment in which they live better is called **natural selection**.

CHARACTERISTICS OF ANIMALS TO BE SELECTED

- High rate of egg laying and good size of eggs produced.
- Good mothering ability i.e. ability to suckle the young ones.
- Good breeding habit.
- Faster growth rate.
- Low infant mortality (death of young ones).
- High fertility.
- High meat quality and quantity.
- Efficient in converting pastures to high quality products e.g. milk, meat (feed conversion).
- Disease resistance.

- Healthy and strong - looking.
- Ability to work e.g. oxen.
- Docile (easy to handle).

2. Breeding

A. Inbreeding: This involves the mating of closely related animals e.g. mother and son, father and daughter.

ADVANTAGES

- It brings uniformity in the animals.
- Continuous inbreeding helps to fix desirable genes leading to production of pure breeds.

DISADVANTAGE

- It results in low vigour (energy and strength) and performance because other characteristics like weaknesses are passed on by the parents.

B. Outbreeding: This refers to the mating of animals that are not closely related. They can be of the same breed (**out - crossing or line- crossing**) or different breed (cross- **breeding**) The advantage is that it introduces new blood in the herd which improves performance of the offspring. This superiority in performance is called hybrid **vigour or heterosis** e.g. Malawi Zebu can be crossed with Fresian bull resulting in more milk production.

3. Introduction: This is the practice of bringing exotic pure breed animals with desirable characteristics into one's own country e.g. Jersey and Fresian were introduced in Malawi from Europe and America for milk production.

Introduction can also be done by Artificial Insemination where sperms are collected from the male using an artificial vagina.

ADVANTAGES OF ARTIFICIAL INSEMINATION

- The cost of buying and keeping a bull is eliminated thus making it a cheaper method.
- The spread of sexually transmitted infections is reduced, as natural mating is not involved.
- The sperms can be stored for some time and used when required.
- Semen from one male can be used to serve many females e.g. 1 bull: 200 cows.
- Semen from heavy males can be used to service even small females; which would not be naturally easy.
- It is easy to plan the breeding programme.

DISADVANTAGES

- It is expensive to set and maintain an artificial insemination programme.
- Timing may be a problem since it is difficult to determine with certainty when the cows are on heat.
- Communication with artificial insemination experts may be difficult due to distance.

TOPIC 8: BEEF PRODUCTION

This is the keeping of cattle mainly for the provision of meat. Local (indigenous) breeds for beef include Malawi Zebu and exotic breeds are Brahman, Charolais, Boran and simmental.

CHARACTERISTICS OF BEEF CATTLE

Rectangular/square/blocky shape. They have short legs. They grow fast and mature quickly. They are good grass eaters (foragers). They have heavy bodies with a lot of flesh.

MANAGING BEEF CATTLE

1. HOUSING

- A. EXTENSIVE SYSTEM:** This is where cattle are grazed on communal grazing areas. Ranching is another form of extensive system.

ADVANTAGE OF THE EXTENSIVE SYSTEM

- It is cheap since the animals feed on communal land.

DISADVANTAGES

- It leads to overgrazing due to too many cattle that are kept.
- It is difficult to control parasites and diseases.
- Animals lose weight easily due to frequent movements hence they take long to mature.

B. INTENSIVE/CUT AND CARRY/ZERO GRAZING

This is where cattle are kept either in stalls where they are fed in feedlots or paddocks where rotational grazing is practised.

ADVANTAGES

- * They fatten up quickly since movement is restricted.
- * It is easy to control parasites and diseases.

DISADVANTAGES

- * It is expensive to feed the animals in stalls.
- * It is labour - involving to carry the feed to the stalls.

NB: Three to four weeks before slaughter, animals are given concentrates in form of bean meal, bone meal, salt to **finish them up** (make them reach slaughter weight quickly).

2. BREEDING

- Malawi Zebu can be cross - bred with exotic breeds like Brahman.
- The bull for mating should be 18 months old while the heifer should be 2 years old with a recommended ratio of 1 male to 20 or 30 females.
- Best time for breeding is two months before the start of rainfall to ensure that calves get plenty of grass by the time they are born.

CARING

Practice	Meaning	Importance	How it is done, equipment required and timing
Castration	Removal of testes	<ul style="list-style-type: none">• Prevents inbreeding• Makes the animal docile• Animal fattens quickly and improves meat quality	<ul style="list-style-type: none">• Testes are removed by using a knife or elastic band (elastrator)• Burdizzo is used to crush the spermatic cord <i>NB:</i> This should be done just before the calves are weaned (stopped from sucking milk from

			their mother) at 6months.
disbudding	Stopping the growth of horn buds	<ul style="list-style-type: none"> • Animals without horns are safer to handle • Prevents animals from hurting each other and the people looking after them 	<ul style="list-style-type: none"> • Caustic soda can be applied on the horns • Use a dehorning iron • Apply anaesthetic to minimise pain in the calf
dehorning	Removing the horns from the cattle	<ul style="list-style-type: none"> • Protects other cattle and people looking after them 	<ul style="list-style-type: none"> • A hot iron and a saw can be used
branding	Placing an identification mark or a number on the animals	<ul style="list-style-type: none"> • For easy identification 	<ul style="list-style-type: none"> • Cold (frozen) or hot branding irons are pressed onto the skin of the animal leaving or burning the numbers into the skin.

PEST AND DISEASE CONTROL

Disease	Causal organism and mode of transmission	symptoms	control
East Coast Fever	- caused by protozoa - transmitted by brown and red ticks	<ul style="list-style-type: none"> • High temperature • Loss of appetite • Excessive salivation • Diarrhoea 	<ul style="list-style-type: none"> • no treatment • restrict movement of animals (quarantine) * control ticks by dipping cattle
Red water	- caused by protozoa - spread by blue, brown and red tick	<ul style="list-style-type: none"> • high temperature • red urine 	<ul style="list-style-type: none"> * dipping cattle * control movement of cattle * vaccinating all suspected animals
Gall sickness	- caused by bacteria - spread by blue tick	<ul style="list-style-type: none"> • high temperature • lack of appetite • pale mucous membranes • death 	<ul style="list-style-type: none"> • use antibiotics e.g. tetracycline • dipping

Heart water	<ul style="list-style-type: none"> caused by bacteria spread by both ticks 	<ul style="list-style-type: none"> high temperature convulsion death 	<ul style="list-style-type: none"> antibiotics dipping vaccinating
Foot and mouth	<ul style="list-style-type: none"> caused by virus 	<ul style="list-style-type: none"> high fever blisters on the tongue, in the mouth and on the skin lameness difficulties in eating 	<ul style="list-style-type: none"> no treatment restrict movement of stock slaughter and burn infected animals vaccinate all other animals
Rinderpest (cattle plague)	- caused by virus	<ul style="list-style-type: none"> high fever red urine sores on the mouth and nostrils excessive salivation diarrhoea blood stained faeces 	<ul style="list-style-type: none"> no treatment slaughter affected animals quarantine regular vaccination (every 6 months)

Mastitis	- caused by bacteria - spread through teat canal	<ul style="list-style-type: none"> high fever swollen udder and teats blood/pus-stained milk 	<ul style="list-style-type: none"> use tetracycline or penicillin practise hygiene during milking
Tuberculosis	- caused by bacteria - spread through close contact with other animals	<ul style="list-style-type: none"> temperature rises and falls suddenly (fluctuation) loss of weight diarrhoea persistent coughing thick - white vaginal discharge sterility (inability to bear a young one) 	<ul style="list-style-type: none"> test with tuberculin and slaughter all animals that react positively Vaccinate young animals with B.C.G.

Black quarter	- caused by bacteria - spread through ingestion of spores	<ul style="list-style-type: none"> • High fever • Loss of appetite • Lameness • One of the legs becomes swollen • Sudden death 	* Treat with antibiotics * Burn dead animals * Vaccinating suspected animals
Anthrax	- caused by bacteria - spread through ingestion or inhalation of bacterium	<ul style="list-style-type: none"> • Animals suddenly drop dead • Blood stained discharge mostly from the anus and nostrils 	<ul style="list-style-type: none"> • No treatment • Bury dead animals • Vaccinate remaining animals
Brucellosis (contagious abortion)	- caused by bacteria - spread through contact	<ul style="list-style-type: none"> • Abortion • Genital organs in cows are inflamed • Swollen testicles in bulls 	<ul style="list-style-type: none"> • No treatment • Slaughter affected animals • Vaccinate remaining stock
Trypanomiasis (nagana)	- caused by protozoa (trypanosomes) - spread by tsetse flies	<ul style="list-style-type: none"> • Frequent fever • Dullness • Anaemia • Death 	<ul style="list-style-type: none"> • Treat with berenil • Control ticks by spraying • Slaughter badly infected animals

EXTERNAL PARASITES

TICKS: They can be found under the tail, around the scrotum, ear, dewlap, around the eyes and anus.

They are harmful because:

- They suck blood causing the animal to be anaemic.
- They damage the hides (skin) of cattle
- The bites may be a cause of infection e.g. mastitis in dairy cow.
- They transmit tick - borne diseases e.g. East Coast Fever, Gall sickness, Heart water.

TYPES OF TICKS

1. One - host tick: This one feeds on one animal

2. Two - host ticks: Larva and nymph stages take place on the first host. The nymph develops into an adult and climb on to the second host.

3. Three - host ticks: Larva, nymph and adult complete their stages on three different hosts.

CONTROL

Dipping the animals or hand - spraying them.

TSETSE FLIES

- They irritate and weaken cattle.
- They transmit a disease called trypanomiasis CONTROL

- * Spraying the animals »J» Clearing bushes around

INTERNAL PARASITES

Parasite	Damage caused/sign of attack	control
Roundworms	<ul style="list-style-type: none"> • Attack the intestines and absorb digested feed from the animal • Enlarged stomach referred to as pot belly, especially in calves • Slow growth • Continuous diarrhoea (scouring) 	<ul style="list-style-type: none"> • Animals to be regularly dewormed (dosed or drenched with drugs) e.g. phenothiazine • Rotational <i>grazing</i> to reduce the build up of worms
Tape worms	<ul style="list-style-type: none"> • Affect the small intestines and suck digested feed. 	<ul style="list-style-type: none"> • Dose the animals with suitable drugs • Practise rotational grazing
Liverfluke	<ul style="list-style-type: none"> • Attack the liver • Cause general weakness and internal bleeding in animals 	<ul style="list-style-type: none"> • Destroy the snail which is the immediate host, using copper sulphate • Avoid grazing animals in wet dambos • Practise rotational grazing

MARKETING

1. Feeder grade: These are young animals weighing g about 225 kgs.
2. Standard grade: These are cows and bulls that look well fleshed and in good condition.
3. Commercial grade: Those that are in fair condition.
4. Inferior grade: Cattle below the grades above.

TOPIC 9: DAIRY PRODUCTION

This is the rearing of cattle mainly for milk production

IMPORTANCE OF DAIRY PRODUCTION IN MALAWI

- * Dairy products are nutritious e.g. milk contains carbohydrates, proteins, fats, minerals and vitamins.
- * Dairy products are a source of reliable income.
- * Dairy production provides a source of employment.

CHARACTERISTICS OF DAIRY CATTLE

The body is lean (without too much flesh and angular.

- The body is wedge - shaped i.e. deeper at the rear thanlifthelr6nt with strong hind quarters to support the udder.
- It has a very large udder with teats that are evenly spaced.
- The legs are short and strong.

NB: (I) The Malawi Zebu is an indigenous milk breed producing less milk but able to adapt to local conditions.

- (ii) The Fresian is an exotic breed with high rate of milk production but needing proper care.

FACTORS THAT AFFECT MILK YIELD

- Age of the animal: Milk increases with each calving up to fifth lactation.
- Nutrition or feeding: Feed for both maintenance and production is essential.
- Character of the cow: Dairy cow should be docile.
- Health: Diseases such as mastitis and milk fever affect the quality and quantity of milk produce
- Season /time of the year: Availability and quality of pasture is important for milk production.
- Period of lactation: The cow dries off 305 days after calving therefore milk production begins to decrease. This is called lactation curve.
- Milking frequency: The recommended frequency is twice a day.
- Treatment of the cow: Gentle treatment is required to avoid holding up the milk.
- Milking techniques: Overmilking damages the teats while undermilking can make the cow to dry up quickly.

MANAGING DAIRY COWS

1. HOUSING

- Four cows are recommended for a pm.
- Beddings should be provided in the khola.
- A separate pen should be constructed for calves.
- A milking shed should be constructed with a floor made of rough concrete and sloppy for easy cleaning and draining.
- A separate area for storing feed, drugs and utensils should be provided.
- Provide a neck yoke for restraining the animal during milking.
- A feed trough should also be provided.

MILK HYGIEN

To avoid bacterial infection, the milker should:

- Wash his/her hands with soap before milking.
- Wash the milking utensils with warm water.
- Wash the udder and teats with warm water and mild disinfectants.
- Give the cow some concentrates to feed while the cow is being milked.
- Draw a little milk from each teat into a strip cup to check signs of mastitis.
- Milk the cow gently and quickly i.e. within 8-10 minutes.
- Pour the milk into a cooler to slow down the growth of bacteria.
- Pour the milk through a filter paper fitted into a funnel to remove any impurities.

BREEDING

- Mating should be done during the second or third month after giving birth.
- The recommended months are between mid - December and mid - March so that calving coincides with the onset of the first rains.
- For improved milk production, Malawi Zebu should be cross - bred with a Fresian bull.
- Cows should be steamed up (given concentrates) two months before calving so that they build up the body.

CALF REARING

- > Calves should be allowed to suckle their mothers during the first 3-4 days only so that they get colostrum which is rich in nutrients.
- > After the fourth day, the calves are fed whole milk in buckets up to 3 months.

FEEDING

- During the dry season, grass needs to be supplemented with crop residues e.g. groundnuts haulms, bean and pea straws and sweet potato vines.
- Hay and silage should also be provided.
- Molasses diluted in water can be included to increase sugar content.

DISEASE AND PARASITE CONTROL

Disease	cause	symptoms	control
Mastitis	<ul style="list-style-type: none"> • Bacteria • Bad milking practices 	<ul style="list-style-type: none"> • Swollen and inflamed udder • Blood/pus clots in milk 	<ul style="list-style-type: none"> • Treat with antibiotics e.g. penicillin • Observe cleanliness during milking
Milk fever	<ul style="list-style-type: none"> • Low level of calcium in the blood stream • Excessive production of milk soon after calving 	<ul style="list-style-type: none"> • Paralysis and unconsciousness • The animal lies down and has difficulties in getting up • Death may occur in severe cases 	<ul style="list-style-type: none"> • Call for a Veterinary Officer to administer a calcium phosphorus solution through the jugular vein • Feed dairy cows with calcium - rich feed or bone meal two months before calving

TOPIC 10: TRADING IN AGRICULTURAL COMMODITIES

Trading means buying and selling of commodities normally to make a profit. Marketing is a process that involves the identification of consumer needs (by conducting market research) and satisfaction of these needs (through grading, processing, transporting, storage, risk bearing and buying and selling at a profit).

IMPORTANCE OF TRADING OF AGRICULTURAL COMMODITIES AT:

A. COMMUNITY LEVEL

- It encourages each community member to engage in an enterprise that is most rewarding to him/her.
- Everyone benefits when producers of different commodities sell their goods to one another.
- Income from sales raises living standards of all concerned.
- Trading promotes specialisation i.e. people concentrate on a particular enterprise and develop more expertise (skill) in that enterprise.
- It provides efficient division of labour
- It provides an outlet for surplus from the farm holdings.

B. NATIONAL LEVEL

- It creates work opportunities.
- It promotes more efficient allocation of resources e.g. land, labour or capital.
- It increases national output since workers are more productive through specialisation.
- It promotes development of local agro - based industries through the provision of raw materials and markets for finished products.
- It enables farmers to convert agricultural commodities into cash.

- It enables the urban population to obtain food.

C. INTERNATIONAL LEVEL

- Enables nations to earn foreign currency.
- Enables each country to import what it does not produce.
- It offers consumers a wider choice of products.
- It enables a country to obtain funds through taxation.
- It widens the market for agricultural products.
- It creates great pressure on farmers to be more efficient in order to be able to compete internationally.

WAYS OF IMPROVING TRADING IN AGRICULTURAL COMMODITIES AT:

A. COMMUNITY LEVEL

- Promoting good neighbourliness/ peace.
- Promoting the development of Rural Growth Centres e.g. Mbalachanda in Mzimba.
- Improving the rural road network for producers or traders to transport commodities more easily.

B. NATIONAL LEVEL

- Improving transport network.
- Promoting peace.
- Promoting adequate market information.
- Removing surtax on agricultural commodities.

C. INTERNATIONAL LEVEL

- > Promoting good international relations.
 - > Increasing the volume of production for export commodities e.g. tobacco.
 - > Improving transport and storage facilities.
 - > Improving advertisement and sales **promotion** (through trade fairs).
 - > Putting prices that are reasonable i.e. relative to those of competitors.
 - > Establishing a stable and competitive exchange rate.
 - > Improving the quality of agricultural products to attract external buyers.
- Providing adequate information to potential exporter about international markets.
- > Reducing or removing barriers to trade e.g. tariffs import quotas.

TOPIC 11: FARM BUDGETS

A budget is estimate expenditure and how much is to be earned from the produce.

TYPES OF BUDGETS

1. PARTIAL: It is used to evaluate or assess change (usually quite small) to a part of the farming system. It examines the effect the change will have on the profitability of the farm enterprises.

NB: If the costs are more than income, profit will not be realised.

USES OF A PARTIAL BUDGET

- To expand the existing enterprise or make additions to existing enterprises.
- To change one enterprise for another, referred to as **substitution**.
- To introduce a new enterprise.
- To buy new farm machinery or equipment.
- To adopt a change in the method of production e.g. using machine to shell maize than shelling by hand.

2. COMPLETE BUDGET

It is the type of budget which examines the effect of changes made to the whole farm. It can be made when a farmer:

- Is opening a new farm.
- Intends to carry out major reorganisation of the farming system.

NB: For examples, refer to Strides in Agriculture Book 4 ppl 10-111

TOPIC 12: AGRICULTURAL COOPERATIVES

A cooperative is an organisation or a group of people who join together to pool their resources and services to achieve a common goal. These cooperatives help farmers to:

- Produce or market **commodities** cheaply since **they** are bought in large quantities.
- Secure loans from **banks**.
- Buy inputs **cheaply** since they **can be** bought at wholesale price.
- Make use of expensive machinery which can overcome labour shortages.
- Transport their produce to markets easily.
- **Bargain** for better **prices or selling conditions as a group**.
- Sell commodities and share proceeds accordingly.
- Take advantage of storage and processing facilities.
- Quickly adopt innovations in agriculture by sharing expertise and knowledge.

PRINCIPLES FOR FORMATION OF COOPERATIVES

- It should be legally constituted with guiding rules. » Participation is voluntary.
- They are impartial i.e. not based on political or religious grounds.
- It is open to all farming community members i.e. large or small scale.

FACTORS THAT MAKE AGRICULTURAL COOPERATIVES SUCCEED

The staff and committee members need to be trustworthy and have necessary expertise.

- The cooperative should have enough funds.
- The cooperative should be efficiently and effectively organised.
- Staff members managing funds need to be skilled and highly motivated.
- It should have adequate infrastructure e.g. offices, storage facilities.
- Members should receive ongoing and relevant training to improve their productivity and marketing skills.

TOPIC 13: FARM MECHANISATION

This is the modernisation and improvement of operations or methods of production as well as farm structures.

ADVANTAGES OF FARM MECHANISATION

Farm operations are done faster.

It leads to increased production

It makes work easier.

It releases farmer's time for other tasks

DISADVANTAGES

- > It can lead to unemployment.
- > Quality of work may be poor due to speed of operation.
- > Capital and operation costs are high.
- > It is expensive to import tractors and spare parts.

- > Spare parts may be scarce.
- > It requires skills to operate and maintain the machines.
- > Soil is compacted due to use of heavy machinery.
- > Some crops are not easily mechanised and limits the choice of crops to be grown.
 - The fuel to run the machines may not be available.
- > Mechanisation requires larger farm holdings.

FACTORS TO BE CONSIDERED WHEN MECHANISING A FARM

- Size of the farm holdings: It requires large farms.
- Accessibility of the land: Machines such as tractors should easily reach the farm.
- Topography of the land: It is easier to mechanise on a flat land.
- Capital availability: It should be enough to buy machinery and spare parts.
- Technical know - how: There should be skilled labour to operate, maintain and repair the machines.
- Value of the crop: The crop should be of high value to recover the cost of mechanisation.
- Market demand should be high.
- Infrastructure: It requires good roads, electrification and water supply.
- Availability of fuels and oils: These should be accessible and affordable.
- Availability of labour: They are needed to perfect the work done by machines.
- Land tenure system: Some systems like customary may limit mechanisation since it would not be possible to combine small farms to create a bigger one.
- Land for animal feed: Where ox - drawn implements are used, there must be sufficient land for pasture production.

SAFETY MEASURES WHEN USING FARM MACHINERY

- 'When spraying, wear protective clothing.
- Wash your body thoroughly with soap after spraying.
- Do not smoke or eat when spraying crops.
- Avoid spraying against the wind
- Empty chemical packets or bottles should be properly disposed.
- When carrying implements, ensure that the sharp blades face downwards.
- Keep children away from working machines.
- Fuels and oils should be kept in a safe place because they are highly inflammable.
- Do not smoke when there is petrol nearby.
- Check the brakes and the steering of the tractor so that they do not fail.
- Do not allow battery acid to come in contact with your skin because it is highly corrosive.
- Do not wear loose clothing when working with machines.

TOPIC 14: LAND DEGRADATION AND THE ECONOMY

EFFECTS OF LAND DEGRADATION ON THE ECONOMY

- It makes the land more expensive as everyone will want the land that is not degraded.
- It reduces land for grazing and forest reserve.
- The land becomes less productive due to erosion and loss of fertility.
- Gullies formed take up some of the land and make farming difficult.
- It is difficult to reclaim/land that has been degraded.
- Growing crops on that same piece of land yearly will lead to soil exhaustion.
- It leads to loss of top soil which reduces yields.

MAINTENANCE OF FARM MACHINERY

Implements/machinery	Method of maintenance
Hoe	<ul style="list-style-type: none"> ◆ Check that the handle is in good order ◆ sharpen the blade if it is blunt ◆ scrap soil off the blade ◆ store it in a dry place to avoid rust
Panga	<ul style="list-style-type: none"> ◆ replace the short handle if broken ◆ sharpen the blade if blunt ◆ clean the panga ◆ store it in a dry place to avoid rust
Wheel barrow	<ul style="list-style-type: none"> ◆ grease the wheel axle to reduce wear and tear ◆ paint the barrow to prevent rusting
Sprayers	<ul style="list-style-type: none"> ◆ clean the tank after use with lots of clean water ◆ dismantle and clean the nozzles thoroughly, using pieces of grass and not pins to avoid damaging the nozzles ◆ replace piston cups and worn out nozzles ◆ paint the knapsack sprayer during off - season
Ox- plough and ridger	<ul style="list-style-type: none"> ◆ grease the axles, hake/ regulator and the hitch ◆ tighten loose bolts and nuts ◆ set the plough and ridger correctly ◆ Do not drag the plough and ridger when transporting them. ◆ Replace worn out parts such as the landside and share ◆
Ox – cart	<ul style="list-style-type: none"> ◆ grease wheel bearings and hub ◆ tighten loose bolts and nuts ◆ replace worn out parts ◆ check that the tyres have correct pressure ◆ do not overload the ox – cart to avoid overturning ◆ paint the ox – cart and store it in a shed to prevent it from rusting
Mouldboard plough	<ul style="list-style-type: none"> ◆ check the share and coulter ◆ sharpen the share ◆ lubricate the coulter bearings daily ◆ replace worn out share and coulter ◆ clean the plough by scraping off the soil ◆ tighten bolts and nuts ◆ grease the mouldboard, share and landside to prevent rusting
Disc plough	<ul style="list-style-type: none"> ◆ tighten bolts and nuts ◆ grease the bearings ◆ clean and adjust the discs ◆ check and adjust the scrapers ◆ replace worn out parts ◆ oil the disc plough after use to prevent it from rusting ◆ paint the beams
Harrows (spike – toothed and spring – toothed)	<ul style="list-style-type: none"> ◆ tighten all bolts and nuts ◆ grease the bearings ◆ check that the teeth are securely in place ◆ tighten the u – bolts ◆ replace worn out parts ◆ sharpen blunt tines or the points ◆ grease the harrow when not in use to prevent it from rusting ◆ paint the harrow when not in use

TOPIC 15: POPULATION GROWTH AND FOOD SECURITY USING SCIENCE AND TECHNOLOGY TO ACHIEVE FOOD SECURITY

- Plant and livestock breeding: New techniques that have been developed ensure production of high -yielding crops and better livestock breeds.
- Irrigation technology: This has helped to overcome drought as crops can be grown even in the dry season.
- » Fertiliser production technology: The high - analysis fertilisers that have been developed increase crop yields.
- Stock feed manufacturing: Commercial feeds like concentrates additives and livestock hormones ha\ increased livestock yields.
- Pesticide development: This has resulted in more effective control of pests and diseases.
- « Herbicide development: Development of chemical weed killers has also led to increased crop yields.
- Mechanisation: This has helped farm operations to be completed in time.
- Crop processing and marketing: This has ensured that food is kept for a long time.
- Soil conservation and drainage: This has made land more productive as erosion is checked.

DROUGHT - RESISTANT CROPS AND FOOD SECURITY

Examples are cassava, sweet potato, yams, millet, sorghum. They are important because:

- They adapt to drought therefore they can survive even with little moisture.
- They mature early.
- They are easy to store i.e. they can be left in the field and harvested when needed.

TOPIC 16: POPULATION AND LAND POLICY IN AGRICULTURE

Land tenure: This refers to the way in which land is owned or held. It is divided into: **1. Public land:** This is the land held and used by government for

- government buildings and roads
- forest reserves and national parks. Other national infrastructure

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2. Communal (customary) land: This is the type of land owned by a group of people, a tribe or a clan and is held under the control of tribal chiefs or village heads.

CHARACTERISTICS OF COMMUNAL LAND

- Land is held under customary title.
 - Land is distributed to members of the tribe according to their needs.
 - Land is allocated free of charge.
 - The community has the power to describe how the land should be used.
- ### **ADVANTAGES OF COMMUNAL LAND TENURE**

- Since land is allocated free of charge, every member of the community is assured of at least some land.
- There is more security as no member can be evicted (chased away) from the land.

DISADVANTAGES

- Since the land is used under customary law, the farmer can not use it as security to obtain a loan.
- The farmer does not see any need to improve the land since it can not be sold.
- Agricultural technology can not be introduced since the land can neither bought nor sold.
- It leads to fragmentation since it has to be sub - divided to children.
- It leads to overgrazing as there are no restrictions on the number of animals to be grazed.

3. Private land: This is the land held on freehold title or leasehold. It can be bought or sold.

A. Freehold title: This is absolute ownership of land. **ADVANTAGES:** (a) The farmer can use the land as security to obtain a loan.

(b) The farmer can sell the land

(c) The farmer can invest in long term investment DISADVANTAGE: The land may not be fully utilised if the owner is not innovative.

B. Leasehold: This is land that is held for a fixed period (usually 99 years) for a special purpose.

NB: Advantages and disadvantages as in (A) above

LAND DISTRIBUTION POLICY IN MALAWI

- Traditional leaders can distribute customary land to their people.
- Enterprising farmers can lease land for commercial farming from government.
- Government can buy back idle land from large estates and redistribute it to needy and able farmers.

MALAWI'S POPULATION POLICY AND NATIONAL DEVELOPMENT

<* The policy aims at keeping future growth of the population within manageable and sustainable limits while allowing individuals the right to decide the number of children they wish to have.

MALAWI'S AGRICULTURAL POLICY AND NATIONAL DEVELOPMENT

National agricultural objectives are to:

- Achieve and maintain self- sufficiency in food production.
- Expand and diversify crop production.
- Provide opportunities to smallholder farmers to grow cash crops.
- Raise the economic and social welfare of the rural population through increased farm income.
- Conserve natural resources especially soil, water and trees.

TOPIC 17: AGRO - BASED INDUSTRIES

An agro - based industry is company, firm or factory or any manufacturing facility that uses raw materials from the farming sector or produces inputs in the farming sector.

INDUSTRIES IN MALAWI THAT USE RAW MATERIALS

Industry	Raw materials	Products
Grain & Milling Company	Maize	Gramil maize meal
	Wheat	Bread flour
Lever Brothers	Groundnuts, Cotton seed, sun flowers	Cooking oils (Covo)
Illovo Sugar Limited	Sugarcane	Sugar
Chibuku Products Limited	Maize, Millet, Sorghum	Chibuku beer
David Whitehead & sons Ltd.	Cotton lint	Textiles
Cold Storage Ltd.	Cattle	Beef, sausages
Malawi Dairy Industries	Milk	Fresh milk, yoghurt
Press Foods Ltd.	Tea leaves	Chombe tea
	Groundnuts	Tambala groundnuts, Superstar cooking oil
Rab Processors Ltd.	Rice	Super Faya rice
	Maize	Snow white ufa woyera
BAT (Malawi) Ltd.	Tobacco leaf	cigarettes

SOME AGRO - BASED INDUSTRIES THAT PRODUCE AGRICULTURAL INPUTS

Agro - based industry	Inputs
Agrimal (Malawi) Ltd.	Animal - drawn ridgers, ploughs, cultivators, hand - operated tobacco presses, hoes and pangas

OPTICHEM (2000) Ltd.	Manufacturers of NPK fertilisers, 23:21: +4S, direct importers of straight fertilisers like CAN, Urea and Ammonia phosphate
Pannar seed (Mw) Ltd.	Producers and suppliers of hybrid maize and performance -tested vegetable seed
PIPECO (Pipe Irrigation Pump Engineering Company)	Manufacturers of irrigation pipes, hose pipes, borehole pumps, and spare parts
Agricultural Trading Company Ltd.	Suppliers of knapsack sprayers, pesticides, herbicides, fumigation sheets and farm implements
Agro — sack industries	Manufacturer of polythene
Charles Stewart Day Old Chicks Ltd.	Distributors of Hyline and Ross broiler chicks
Rab Processors Ltd.	Stock feeds such as growers' & layers' mash, broiler starter, finisher

ROLE OF AGRO - BASED INDUSTRIES IN SUPPORTING THE GROWING POPULATION

- Equipping farmers with inputs: These can be fertilisers, livestock feeds, improved seeds and breeds and farm machinery. In turn, these increase the income for farmers.
- Processing raw materials: They turn the materials into a form that will be liked by the consumer. Some can be exported and earn foreign exchange.
- Providing a market for agricultural products: Farmers are able to convert the raw materials into cash.
- Feeding and clothing the nation: Industries like Grain and Milling feed the nation while industries like David Whitehead and sons manufacture textile for clothing.
- Providing employment.

TOPIC 18: GENDER AND AGRICULTURAL DEVELOPMENT

Some management decisions that have to be made to improve production and profits on the farm are:

- * What to produce (enterprise)
- * How to produce (technology)
- * How much to produce (size of production)
- * When and where to sell or buy (market decisions)

INCREASING WOMEN'S INVOLVEMENT IN DECISION - MAKING IN AGRICULTURE

1. Social empowerment: This can be done by increasing women's access to education.
2. Political empowerment: This means providing more opportunities for women's participation in decision - making structures.
3. Economic empowerment: This means providing them with opportunities of earning income.
4. Cultural empowerment: This refers to the removal of cultural practices that impact negatively on women e.g. depending on men as providers of basic necessities at home.

TOPIC 19: HIV/AIDS AND AGRICULTURAL DEVELOPMENT

IMPACT OF HIV/AIDS ON AGRICULTURAL DEVELOPMENT

- Weakening the labour force: It reduces the individual's energy output which reduces agricultural production.
- Taking time away from farming: Most family members tend to give maximum care to their sick relative hence ending up neglecting their farms which results in low yields.
- Killing the most productive farmers in the population.

- Depleting farm capital: Families spend lots of money on medical drugs. This is the money that would have been used to purchase fertiliser. Taking care of orphans may also use up farm finances.
- Disturbing the emotional balance of the farmer: Those affected live a life of despair and hopelessness. This may lead to mental disturbances which may affect the ability to contribute meaningfully to agricultural efforts on the family.

M.S.C.E. AGRICULTURE: QUESTIONS & MODEL ANSWERS i

1. Give four ways of maintaining and improving soil structure.

- Cultivating at the right moisture content so that soil aggregates are not broken down.
- Using machinery properly as heavy machinery makes the soil compacted.
- Adding manure and other organic matter, which produce a cementing effect.
- Avoiding overgrazing which makes the soil vulnerable to erosion.

2. Explain briefly how the following factors affect soil pH.

- Use of acid-forming fertilisers- continuous and heavy application of sulphate of ammonia makes the soil acidic.
- Microbial activity- it increases soil pH as hydrogen ions are released during decomposition of organic matter.
- Nutrient uptake by plants- When crops are harvested, nutrients absorbed by plants are also lost and this lowers acidity of the soil.

3. Define crop improvement and state its two main objectives.

- This means increasing the productivity of cultivated plants by developing better cultivars (cultivated varieties) which possess superior characteristics.
- Its main objectives are to increase the average crop yield (yield quantity) and to improve the quality of the produce (yield quality).

4. What do the following pasture seed treatments mean?

- Hulling: The removal of the pod from around the seed.
- Scarification: Where the hard testa (seed coat) of some legumes is softened in order to speed up germination.
- Inoculation: The process of mixing legume seed with the correct type of rhizobium bacteria before sowing to ensure successful nodulation and nitrogen fixation.

5. Mention two advantages and disadvantages of asexual propagation in plants. ADVANTAGES

- It reduces the juvenile period of plants as vegetatively propagated materials assume the age of their parents.
- Vegetative organs are able to withstand environmental hazards in the field.

DISADVANTAGES

- The risk of transferring diseases to the young plants is high.
- Some of the procedures in vegetative propagation need specialist knowledge.

6. Briefly describe three causes of gender bias in agricultural technology.

- Lack of socialisation to technology: Since boys are exposed to technological innovations early in their lives, this prepares them in dealing with the technology in future as compared to girls.
- Lack of exposure to role models: There are few older women in technologically-challenging positions who younger females can copy.
- Lack of confidence: girls are unlikely to work comfortably with technological equipment because they appear new to them.

7. Pasture can be conserved as Hay or Silage. What three factors affect hay quality?

- Stage of growth at cutting: mature and old plants tend to be fibrous, indigestible and less palatable.

- Presence of foreign materials: Weeds, poisonous plants and foreign materials lower the quality of hay and even make it dangerous.
- Storage: wet or leaking storage facilities lower its nutritive value.

8. The government of Malawi is advocating the use of irrigation through the distribution of treddle pumps to all farming communities to ensure food security. However, there are problems associated with this innovation. Outline three problems and their solutions.

- **Salt accumulation- can be controlled by flooding salt-free water.**
- **Soil erosion- can be reduced by proper maintenance of irrigation structures e.g. furrows.**
- **Waterlogging: can be solved by controlling the amount and frequency of irrigation.**

9. What is meant by oestrus in animals and what four signs can a cow show that it is undergoing this process?

- **It means heat period thus when the female animal shows the desire to mate. SIGNS**
- **The cow becomes restless.**
- **The cow mounts other cows and stands still when mounted.**
- **There is mucous discharge from the vulva.**
- **There is an increase in urination.**

10. What do the following methods of selecting animals for breeding mean?

- (a) **Artificial: The selection of animals based on desirable characteristics or good qualities.**
- (b) **Natural: The selection of animals based on their suitability to the environment in which they are living.**

11. Enterprise combination in farming can either be comparative, supplementary or complementary. Define these terms and give an example on each.

- **Comparative: This is where an increase in one enterprise results in the decrease in the other as they compete for the same resources e.g. land. An example is maize and tobacco which a farmer may want to plant on the same piece of land.**
- **Supplementary: Where an increase in one does not affect the other because one enterprise may find itself benefiting from the other e.g. maize and groundnuts.**
- **Complementary: When each contributes to the production of the other e.g. poultry and vegetable production.**

12. What is marketing margin and in what three ways can it be reduced?

- **This is the difference between the cost of buying the produce and selling it to the customer. WAYS OF REDUCING**
- **Performing other marketing functions e.g. grading.**
- **Raising the price.**
- **Skipping some marketing agencies e.g. selling directly to wholesalers.**

13. What is the main function of ovaries in a female animal?

- **To produce ova or eggs and to secrete sex hormones oestrogen and progesterone.**

14. Define marketing channels and distinguish direct from indirect marketing channels.

- **These are routes through which farm produces move from point of production (farmer) to point of consumption (consumer).**
- **Direct is where farmers deliver their produce to the final consumer themselves. Indirect is when farmers use intermediaries (middle persons) to get the produce to the final consumer.**

15. Seed rate is the weight (amount) of seed required per hectare. What three factors affect the seed rate of pastures?

- **Purity of the soil: If the soil is mixed with a lot of trash (weed seeds) more seeds will be required to achieve desired population.**

- **Seed size: Small-seeded species are sown at lower seed rates since there are more seeds per kilogram.**

- **Method of sowing: Some methods require more seeds because they result in reduced survival of**

e.p. hrnadcastine.

16. What do the following ways of caring for calves mean: *

- (a) Castration: removal of testes
- (b) Disbudding: Stopping the growth of horns.
- (c) Dehorning: Removing the horns from cattle.
- (d) Branding: Placing an identification mark or a number on the animals.

17. Outline four reasons for keeping farm records

- They help the farmers in timing various farming activities.
- They help farmers to budget, as they are able to forecast the expenses and expected income on the farm.
- They help farmers to obtain loans from money lending institutions.
- They help farmers to select the type of livestock to keep.

18. Milk yielding can be affected by several factors. Briefly describe three of them.

- Nutrition: If cows are given enough maintenance and production feed, they produce more milk.
- Seasons of the year: Milk production increases when there is plenty of grass.
- Treatment of the cow: If the cow is treated gently during milking, it is likely not to hold up the milk.

19. Define the following in Enterprise combination:

- (a) Opportunity cost: It is the return that is given up i.e. the farmer might debate whether to rear animals or grow crops during a particular season.
- (b) Comparative advantage: This is a principle which enables farmers to concentrate only on those enterprises that are suitable for the area.
- (c) Risk: This is the difference between what one expects and the actual outcome.
- (d) Uncertainty: This is the state of not knowing what will happen in future.

20. What is a partial budget and under what circumstances can it be used?

- It is a type of budget which is used to evaluate a small change to a part of the farming system. USES
- To expand the existing enterprise.
- To change one enterprise for another (substitution).
- To introduce a new enterprise without changing other enterprises.
- To buy new farm machinery.
- To adopt a change in the method of production.

21. Many farmers choose to work in a group or cooperatives. What are cooperatives and what factors can make them succeed?

- This is an organisation or group of people who join together to pool their resources and services to achieve a common goal.

FACTORS FOR SUCCESS

- The staff and committee members need to have necessary expertise and be trustworthy.
- The cooperative should have enough funds.
- It should have adequate infrastructure.
- Members should receive ongoing and relevant training.

22. Differentiate between *crop diversification* and *mixed farming*.

- Crop diversification means growing more than one crop within the same season while mixed cropping means growing crops and raising animals on the same farm.

23. What four factors are considered when selecting appropriate pasture grasses and legumes?

- Adaptability to the environment.
- Proposed duration i.e. whether it will be temporary or permanent pasture.
- Compatibility with other species
- Resistance to local pests and diseases.

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24. Soil colour tells us about a number of things. Outline four of them.

- Soil's aeration
- Soil drainage
- Presence and amount of organic matter
- The type of parent material.

25. What is salinity and give three salts associated with it.

- This is the condition of soil that is associated with the accumulation of soluble salts in the soil. These salts can be nitrates (NO_3^-), Sulphates (SO_4^{2-}) and chlorides (Cl^-).

26. What are the functions of the following internal structures of a root?

- Phloem: To transport products of photosynthesis for root respiration and storage.
- Xylem: To transport mineral salts and water absorbed by root hairs upwards.
- Root cap: To protect the apical meristem which is the growing point of a root.
- Epidermis: This is a protective coat for the roots.

27. What is the composition of the accessory glands in a bull?

- It comprises the prostrate gland, cowper's gland and the seminal vesicles.

28. Give four safety measures when using farm machinery.

- Do not smoke or eat when spraying.
- Switch off the engine when fuelling or servicing it.
- Do not smoke when there is petrol nearby.
- Do not wear loose clothing when working with machines with rotating arms.

29. Describe three ways of classifying weeds.

- According to leaf shape: Whether they have narrow or broad leaves.
- According to life span: Whether they can complete their life cycle in a year, two or several years.
- According to preferred habit: Whether they are aquatic (live and grow in water) or non-aquatic.

30. Define the following legislative measures of weed control.

- Prohibition: This is nation-wide forbidding of agricultural materials that may be a source of infection.
- Quarantine: This is the period of isolation and observation of products in sealed compartments long enough for any symptoms to appear.
- Notification order: This is a warning for people to report the occurrence of any pests or diseases.

31. Briefly explain three roles of agro-based industries in supporting the growing population.

- Equipping farmers with inputs: These could be fertilisers, livestock feeds or farm machinery.
- Processing raw materials: Some raw materials have little value which needs to be processed so that they are desired by the consumer.
- Providing employment: Some people earn their income through working in these industries.

32. What four factors should be considered when mechanising a farm?

- Size of the farm: It requires large farms and not small-scattered ones.
- Technical know-how: There is need for skilled labour to maintain and repair the machines.
- Value of the crop: It should be the type of crop that will recover the cost of mechanisation.
- Accessibility of the land: Machines such as tractors should easily reach the farm.

33. What is meant by 'volatilisation'.

This is the release of nitrogen into the atmosphere as gas through the activities of denitrifying bacteria.

34. What is meant by the following methods of mixed cropping:

- (a) Intra-row mixed cropping- where two or more crops are grown within the same ridge.
- (b) Inter-row mixed cropping- where one crop is grown between the rows of another crop.
- (c) Relay- intercropping- where a second crop is sown on the plot while the first one is still growing, established or even maturing.

35. Differentiate *maintenance* from *production* rations.

- Maintenance ration is the amount of feed that the animal needs per day to maintain its bodily processes without necessarily losing or gaining weight while production ration is feed that contains all the essential nutrients and in high proportions.

36. Why is it advisable that farmers should castrate their animals?

- The animals fatten up quickly and produce quality meat.
- It prevents animals from mating and passing on undesirable characteristics.
- It makes the animals docile (easy to handle)

37. What is meant by equilibrium (market) price?

- The price at which the quantity supplied to the market is exactly equal to the quantity demanded.

38. Briefly describe three negative effects of HIV/AIDS on agricultural development

- Weakening the labour force: It reduces the energy output of the farmer which slows down production.
- It takes time away from farming: Relatives fail to concentrate on farming activities as they spend much of their time looking after the sick person.
- Depleting farm capital: Money that would be used for buying farm inputs is used for medication.

39. What is meant by the following systems of land ownership?

- Public land: Land held and used by the government.
- Communal (customary) land: Land owned by a group of people, a tribe or clan under the control of chiefs.
- Private land: Land held on free hold or leasehold registered under the Registration Land Act.

40. Why is the change in maize price referred to as inelastic?

- Because as a staple food, when the price rises, the consumer has no choice but to buy the commodity therefore the price change is insignificant to the buyer (consumer).