AGRICULTURE NOTES 2020

INTRODUCTION TO AGRICULTURE

Importance of Agriculture

- Is a source of raw materials used industries e.g. cotton for textile industries.
- Hides and skins – leather used in industry.
- Sugarcane – sugar industry.
- It provides employment both indirectly and indirectly like Agricultural officers, farm managers and accountants working in agriculture institutions.
- It is a source of income to the farmer through the sale of agriculture products.
- It is a source of food to both the rural and urban human population.
- It is a source of government revenue through taxation government revenue can be used to improve social services like health and education.
- It is a source of foreign exchange through agriculture exports.
- Agriculture is a source of energy used for other purposes e.g. Baggase (waste from sugar manufacture) can be used in producing electricity.
- Trade in agricultural products between countries bring about international relation.
- It can be a source of tourist attraction.

PROBLEMS OF AGRICULTURE IN UGANDA

1. **Pest and diseases** (These attacks both crops and animals leading to low yields) To most destructive crop diseases in Uganda today are: coffee wilt, cassava mosaic, Banana bacterial wilt. In animals the serious diseases are foot and mouth diseases, Nagana and contiguous abortions.

2. Poor transport and communication

Most of the feeder roads in rural areas are seasonally hence affecting transportation of our agricultural products to the market during the rainy season.

3. **Natural disasters** e.g. long drought and floods cause destruction of crop and animals leading to loses. This has been greatly caused by climate changes.

4 **Poverty**

Most of the rural farmers are poor therefore cannot afford the expensive agricultural unit like fertilizers, wood seeds and pesticides.

5. Inadequate knowledge and skills:

Most farmers lack enough knowledge which has greatly affected their level of production. E.g. most of them cannot read or write hence cannot take instructions on pesticides.

6. **Poor crop varieties and animal breeds:**

Crop and animals being raised are of low production leading to loses.

7. **Poor technology/tools used;**
The majority of the farmers are using poor tools that cannot support large scale products.

8. Poor funding of agriculture sector by government.

9. The funding of agriculture are still very low which affect the level of production.

10. Price fluctuation. Due to over production and bad weather, prices for agriculture products are not stable which affect the farmer's income.

PROBLEMS OF AGRICULTURE IN UGANDA

High taxes on inputs
This makes agricultural products to be expensive as the cost of production increase.

Conservation
Due to the low education among farmers, they are not willing to change the doing of things.

Inadequate market information
Due to the low technology and remoteness of many rural areas access to market information by farmers difficult.

Competition at the world market
Due to low quality of agricultural produce in Uganda, it may not compete favourably with the product from the developed world.

Land degradation
Due to increasing human population, most of the land available has been over used leading to exhaustion.

SOLUTION FOR AGRICULTURE PROBLEMS

1. Farmers should be provided with loans at a low interest to be used.
2. Pests and diseases should be controlled through growing instant varieties, vaccination.
3. Agricultural reaserch should be carried out improve the quality of seeds and animals.
4. Agricultural research station are;
   Kawanda for crops
   Serere for crops and animals
   Entebbe
   Namulonge

5. Agriculture should be processed to improve quality maintain prices in the market.

6. Storage structures should be constructed so that excess produce is store for future so as to maintain the prices.
7. Government should subsidize agriculture inputs to make it affordable to the farmers.
8. Compulsory, primary and secondary education should be encouraged so that all people receive education to fight ignorance and illiteracy.
9. Farmers should provide with enough marked information through the media and either means.

1. **Local farming systems**

- It is common in the districts of Kumi and Bukenda.
- It is characterized by use of ox – drawn equipment like ox – ploughs.
- The area has light soils sparse vegetation which has encouraged the use of ox – culture.
- The main cash crop grown is cotton while other crops are finger millet, peas, sweet potatoes and sorghum.
- Intercropping is a common practice in this area.

2. Banana and coffee system

- This is practiced in the most fertile places in Uganda around Lake Victoria.
- It covers the districts of Mubende, Masindi, Wakiso, Jinja and some parts of Iganga, Luwero and Kamuli.
- The area receives two seasons of rainfall.
- The man cash crop grown is coffee (Robsta). The common food crops are bananas, sweet potatoes, maize and vegetables, sugarcanes and tea are grown at estates found in Lugazi and Kakira.
- A few animals are kept and ox – ploughing is not common.

3. Banana millet and cotton system

- It is common in the district of Tororo, Namutumba, Budaka, Kamuli, Kiro Nakasongola, Kayunga and parts of Masindi and Kilyandongo.
- Most of these areas have long period of rainfall which begins from April to November
- The main cash crop grown here has been cotton through Robusta coffee is also grown and some areas that have two seasons of rainfall.
- The food crops grown are sweet potatoes, cassava, Maize beans ground nuts and Banana.
- Ox – ploughing is done in some areas since they have light soils.

4. Northern system

This system is practiced in districts of Pachwechi, Gulu, Kitgum, Pader.

The major cash crops are cotton tobacco, sorghum figure millet pigeon peas, simsim, Cassava, sun flower and Ground nuts.

- Intercropping is common while the use of ox-ploughing becomes less common as you move further in North.
- The area receives one long seasons of rainfall from April to October.

5. The west Nile system
   - This system covers the district of Arua, Koboko, Moyo, Adjumani.
   - The major cash crop in this area is cotton and tobacco though Arabica coffee is grown at a high altitude.
   - The food crops are finger millet, sorghum, millet, cassava and peas.

6. Montane system
   - It is practiced around the mountain ranges of Kigezi, Rwenzori and Elgon.
   - The system is similar to the banana, Robasta coffee system but it is modified by relief and population density.
   - The main cash crop from the area is Arabica coffee and tea.
   - The food crops are Bananas, Irish potatoes, Ground nuts, yams, beans, Sweet potatoes, maize etc.
   - Vegetables and fruit like passion fruit are grown for commercial purposes.

PASTORAL SYSTEM

It is practiced by the pastrol tribes of Uganda, i.e. Bahima and Karamajong, Ankole and Bahima.
They often live a nomadic way of life, moving from place to place with their animals.

They grow drought resistant crops like sorghum, bulrush millet, Ground nut and maize.

POPULATION AND AGRICULTURE
Population density is the number of people per square kilometer.

The human population of Uganda has been growing from about 3000,000 in 1962 to 33,000,000 today 2013.

Uganda has one the highest population growth in the world since the women are highly fertile having an average of seven (7) children each.

The highly population growth has a big influence in agriculture which neither negative or positive.

Positive effects of a high population in Agriculture.

- It provides enough labour used in agriculture.
- It provides market for agriculture produce.

- It provides high revenue that can be invested in agriculture to increase production.

Negative effects

- Land available for agriculture production reduces.
- It leads to land degradation due to continuous use of land.
- It may increase level of pollution in the environment as swamps and forests are redeemed.
- Most of the government funds will be spent on social services like education and health living out Agriculture.

CLIMATE AND AGRICULTURE

What is climate?

Climate is the average weather condition of a place recorded and studied for a long period of time.

Weather

Is the daily condition
Is the state of the atmosphere observed studied and recorded a short period of time.

Rainfall

It is the amount of rainfall in an area at a certain time.
Rainfall is measured using a rain gauge. The water is collected during the previous 24hours and measured and recorded. This is done every day for the moth to give a monthly total.

Types of rainfall

1. Relief rainfall
2. Convention rainfall
3. Frontal/ cyclonic rainfall
4. Convergence

The most important attributes of rainfall in agriculture are;

1. Rainfall distribution
2. Rainfall intensity
3. Rainfall effectiveness
4. Rainfall reliability

1. Rainfall distribution

This is the way rainfall is spread over the months in years.
The distribution of rainfall may be described in terms of rain season.

A place with two seasons is referred to as Bimodal rain while that one with a single long season is referred to as **Monomodal rain**.

Rainfall distribution may influence type of crops grown, time of planting and harvesting.

2. Rainfall intensity

This is the measure of the heaviness of rain over a given period of time.
It is measures using a rain gauge.

NB. High intensity of rainfall can result into erosion since the soil not be able to absorb most of the water.

3. Rainfall effectiveness

This is the measure of the amounted rainfall that is able to ensure successful growth of crops.

4. Rainfall reliability

This is the ability of rainfall to come as and when expected. This greatly influences the planting season.

EFFECTS OF RAINFALL IN AGRICULTURE

- It can cause pollination in crops
- It provides water/soil moisture needed for crop growth.
- It regulates soil temperatures
- It provides with water at the farm for washing, drinking etc.
- Provides water needed in seed germination.
- However, rain can be destructive through soil erosion and flooding.

Temperature

It is the measure of the hotness or coldness using a thermometer. Temperature is measures in degrees, centigrade (^oC) and degree Fahrenheit (^oF).
To convert ^oC to ^oF

Example

The average temperature of Mukono Town for the month of March was 28.5^oC. Convert to degrees Fahrenheit

CLIMATE AND AGRICULTURE

Effects of temperature in Agriculture

1. Higher temperatures are used in drying crop produce.
2. It affects the rate of photosynthesis in crops.
3. It affects germination of seeds.
4. It affects the rate of transpiration in crops.
5. Higher temperature may increase the evaporation rate of water from the soil.
6. WIND

   This is moving air and its direction is measured by the wind vane. While the speed is measured by the Anemometer.

Effects of wind in Agriculture

It helps in seed dispersal
It is important in crop pollination
It is a source of power in wind mills
It is used in winnowing of seeds
It is used dying of crop produce
Wind currents can help in rainfall formation.

HUMIDITY
This is the amount of water vapour in the atmosphere. It is measured using a hygrometer.

Effects of humidity
- It affects the rate of transpiration in crops.
- It affects presence of fungal diseases.
- It influences the rate of dying crop produce.
- It may affects environment temperatures

LAND USE /LAND FORMS IN UGANDA

This is the way how land is put to use. In Uganda land is used in the following ways.
- We use land for settlement
- Agriculture
- Mining
- Burial grounds
- Transport and communication
- Industrialization
- Wild life
- Water bodies
- Forests
- Mortgage.

1. Settlement
In this form of landuse, land is occupied by housing estates, schools, hospitals, urban centers etc.

2. Agriculture
This is the biggest form landuse in Uganda. Land is put to a growing of crops and rearing of animals.

3. Mining
This is land which is occupied by mines for copper, phosphates petroleum and sand.

4. Wildlife
This is land occupied by National parks and game reserves.

5. Water bodies

This covers lakes, rivers and springs.

6. Tourism

This refers to land which is occupied by national parks and game reserves. It is a very good source of foreign exchange for the country.

7. Forests

This land is occupied by natural and artificial forests in the different parts of Uganda.

Importance of forests

1. Important in rainfall formation (convectional rainfall)
2. They reduce global warming by absorbing excess carbondioxide from the atmosphere.
3. They provide timber that can be used in the construction of farm structure.
4. They can act as habitants for wild animals.
5. They are a source of herbs used in the manufacturer of medicine.
6. They attract tourists bringing in foreign exchange for the country.

Conservation of forests

These are measures aimed at preserving and protecting forests for generations to come.

Measures of forest conservation

Carrying out agro – forestry
Practice afforestation
Carrying out re – afforestation

1. Afforestation

More areas of land should be turned into forests by planting trees.

2. Re – afforestation

Every tree out should be replaced through planting other trees.

3. Agro – forestry

Trees should be integrated with crops and animals of forests

4. Government should set up strict laws against deforestation.

5. Education

People should be educated about the importance of forests.

6. Use of alternative sources

Government should encourage the use of alternative sources of fuel like biogas, petroleum, solar.

7. Rural electrification should be encouraged to reduce the dependence

FARMING PRACTICES

Subsistence farming

This is the growing of crops for consumption and selling the surplus.

Forms of subsistence farming

- Shifting cultivation
- Rotational bush furrowing
- Nomadic pastoralism.

Advantages of subsistence farming

- It requires les land to be practiced.
- It requires less initial capital
- It requires simple tools that are cheap
- It requires less labour since it mainly depends on family labour. (Women and children).
- It requires less skills to be practiced.
- It uses cheap inputs.

Disadvantages of subsistence farming

- It leads to poverty because the peasants lack income
- Production is low which may easily lead to food.
- It reduces government revenue since peasants are difficult to tax.
- It may lead to soil exhaustion due to poor methods of farming practiced.
- It increases unemployment in the community.

Shifting cultivation

This is where a farmer clears land uses it until it loses fertility then she/he moves to fresh place.

Characteristics of shifting cultivation

- Land is cleared by cutting and burning vegetation.
- It is practiced in areas with low human population
- Simple tools are used
- Small areas are cleared
- Few annual crops are grown.
- Intercropping is common
- Little attention is given to the crops
- Crops are mainly grown for home consumption.

Advantages of shifting cultivation

1. It uses simple tools therefore it is cheap to maintain.
2. The use of fire makes clearance of land easy
3. Bush burning adds, more minerals to the soil.
4. Intercropping guards against crop failure.

5. It is easy to control pests and diseases since the farmers can move to a fresh place.
6. Crop yields are usually high due to use of fresh land.
7. There is less weeding as the fire used can burn weeds seeds.

Disadvantages of shifting cultivation

1. Bush burning leads to the destruction of soil living organisms.
2. It can only be practiced in areas with low population.
3. It cannot provide enough food for a big population.
4. It may leave the land bear and exhausted which exposes it to erosion.
5. It leads to massive destruction of forests.

Nomadic Pastoralism

Nomadism: Means moving from one place to place to another.
Pastoralism means rearing of animals more especially cattle.
Therefore
Nomadic Pastoralism
Is the practice is the rearing of cattle while moving from one place to another. In search for water and pastures for the animals.

Characteristics of nomadic Pastoralism

1. They keep very large number of animals.
2. There is movement from place to place.
3. There's growing of few annual crops on a small scale.
4. Animals kept are of poor breeds.
5. Poor animal husbandry practices are carried out.
6. Over grazing is common which leads to soil erosion.
7. Animals depend on natural pastures.
8. Animals are grazed on land owned by the community.
9. The practice is mainly carried out in the arid and semi-arid areas.

Problems faced by pastoral nomadism

1. Poor weather leading to drought.
2. Walking long distances
3. Lack of pasture for the animals
4. Poor breeds of animals kept.
5. Cattle rustling which leads to death
6. Lack of water for animals
7. Parasites which attack animal leading to poor breeds.
8. Pastoralists may be attacked by tropical diseases which lead to death.
9. Conservatism.
10. Poor veterinary services
11. Poor housing of animal
12. Shortage of land

INTERCROPPING

This is the growing of a major crop together with a minor crop on the same piece of land at the same time. E.g. maize and beans, cassava and beans, maize and groundnuts, coffee and banana.

Advantages of intercropping

1. A farmer may get a balanced diet when her production legumes and cereals at the same time.
2. A farmer gets double income after selling the 2 crops.
3. The weak plants can be supported by the strong ones e.g. maize can support the climbing beans.
4. Growing legumes together with other crops maintains soil fertility since nitrogen is fixed by the legumes.
5. It guards against total loss to the farmer since failure from one crop can be covered by the other.
6. Production per available land is high since land is utilized maximally.
7. Weeds are easily controlled since they are denied space.

Disadvantages of intercropping.

1. It is difficult to weed a garden that has more than one type of crop grown together.
2. The number of pests and diseases increase due to a variety of food source.
3. There is high competition of nutrients between crops which may result to low yields.
4. Spraying of crops against pests and diseases is difficult.
5. Much more labour is required in carrying out agronomic practices.
6. It can easily lead to soil exhaustion due to the high intake of nutrients from soil by the different crops.
7. Difficult to use machines when carrying out operations like weeding.
8. It is difficult to apply fertilizers and manures to the crops in the garden.

Modern farming/systems

1. Mixed farming
2. Plantation farming
3. Intensive farming

1. A farmer gets double income i.e. from crops animals sold.
2. A farmer gets a balanced diet by eating crops and animals products.
3. Animals can provide manure (from yard manure) that can be used to improve soil fertility for proper crop growth.
4. Crop residues and products can be fed to animals therefore reducing feed costs.
5. The practice guards against total loss to the farmer since failure in crops can be compensated by animals.

6. Animals can provide labour used in Ploughing and transportation of plant produce.
7. It ensures income to the farmer throughout the year.
8. Labour is efficiently utilized throughout the year.

Disadvantages of mixed farming

- It requires a high initial capital
- It is expensive to maintain
- It requires a large piece of land to be carried
- It requires more skills to be carried out.
- It requires much more labour
- It requires a large piece of land to be carried out.
- It requires much skills to be carried out

Plantation farming

This is the growing of one type of crop on a large scale using scientific methods of farming.

The plantations can also be referred to as estates.
In Uganda, sugar cane and tea are the main crops grow on plantations.

Characteristics of plantations

1. The form concentrates on production of a single crop e.g. sugarcane plantations in Kakira, Lugazi and Kinyara.
2. The farm covers hundreds of hectares
3. Crops are grown for commercial purposes
4. There's use of machines when carrying out farm operations
5. A lot of capital is required to set up a plantation.
6. It employs a large labour force
7. Scientific methods of farming are used

Advantages of plantation farming

1. It provides employment to both skilled and unskilled labour
2. It is a source of government revenue through taxation.
3. They earn foreign exchange to the government by exporting products
4. They engage in Agriculture research which encourages development
5. They provide high quality agriculture products.
6. The encourage development of out-growers.
7. Plantation provide social services e.g. health and education to the workers

Disadvantages of plantation farming

1. It may lead to displacement of people during establishment.
2. Production of a single crop on the same piece of land for a long time may lead to soil exhaustion
3. Plantations may cause environmental degradations by encroaching on forests and wetlands
4. It requires a lot of capital to establish a plantation.

5. Foreigners who own these plantations take most of the profits outside the country.

Intensive farming;
This is the use of scientific methods of production in agriculture on a small area to produce high yields.
The scientific methods of production are;
(i) Use of fertilizer and manures
(ii) Use of pesticides i.e. Herbsites, insecticides, acasides, wormicides etc
(iii) Use of drugs and machines to treat livestock
(iv) Irrigation of crops
(v) Use of improved crop seeds and animal seeds.
(vi) Use of machines in carrying out farmwork
(vii) Use of high quality labour /skilled labour
(viii) Use of green houses in growing crops

SOIL AND SOIL SCIENCE
This is a mixture of weathered rock materials and organic matter which are formed through physical, chemical and Biological processes.

Or
It is the outer most layer of the earth's crust where plants grow and derive nutrients.

Or
It is a natural body of loose unconsolidated material which constitutes a thin layer of several meters deep on the earth's surface.

SOIL FORMATION

Soil is formed through the process of weathering.

WEATHERING
This is the process of breaking down or the disintegration of rocks to form soil.

The rocks that form soil are of three types i.e. igneous rocks, sedimentary rocks, and metamorphic rocks.

IGENEOUS ROCKS
These are rocks formed by the cooling and solidification of molten magma (Larva) extracted at high temperature from the interior regions of the earth's crust near on the surface of earth.

The main types of igneous rocks are:-
Granite, diorite, and basalt and gabbro. The minerals present in these rocks are mica, feldspar, quarts, iron oxides and biotite.

SEDIMENTARY ROCKS

These are formed by the deposition of weather minerals which are derived from igneous rocks. E.g. shales, sand stone, and limestone. The minerals in these rocks are clay minerals, quartz, calcium, phosphate, dolomite, iron oxides.

METAMORPHIC ROCKS

These are formed by the action of heat, pressure and chemical changes on igneous and sedimentary rocks e.g. gneiss, schist, slate, and quartzite

TYPES OF WEATHERING

There are three main types of weathering i.e. physical weathering, chemical weathering and Biological weathering.

PHYSICAL WEATHERING

This is the mechanical disintegration of rocks which is caused by heat, roots of trees, ice, wind and rain.

HEAT

When rocks are heated, they expand unevenly between their layers. A change in temperature will set up stresses which will result into breaking of rocks.

ICE

When water cools to form ice, it expands. Therefore, the presence of water in rocks cracks can lead to the breaking of rocks when it cools to form ice

RAIN

Rainfall particularly that with hail stones falls on rocks surfaces crashing and removing some particles from them which are carried by the running water.

WIND

As strong wind, blows it carries away tinny rock particles to different places from the mother rock.

PLANT ROOTS

As roots penetrate through the rock cracks, they will cause further cracking as they increase in size through growth.

CHEMICAL WEATHERING

This is aided by physical weathering which increases a greater surface area of rock exposed to chemical weathering. Chemical weathering is the chemical transformation or decomposition of parent rock mineral materials into new mineral complexes.

TYPES OF CHEMICAL WEATHERING

This includes hydrolysis, hydration, oxidation, carbonation, reduction, and solution.

HYDRATION

This occurs when water combines with minerals, silicates and oxides of iron or aluminum to form hydrated compounds e.g.

$Fe_2O_3 + 3H_3O \longrightarrow 2Fe_2O_3 + 3H_2O$.

The hydrated compound are softer than the original rock and therefore easily worn away.

OXIDATION

This is where atmospheric oxygen and free oxygen contained in rain water convert rock minerals to oxides. These oxides usually take more space and thus help to break up the rock e.g. $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$

HYDROLYSIS

This is the use of water to break up chemical bonds of a particular compound e.g

$KAlsi_3O8 + H_2O \longrightarrow KAlsi_3O_8 + KOH$

REDUCTION

This occurs in wet, badly drained and poorly aerated sights such as deep zones of the earth's crust. It involves the removal of oxygen from minerals

e.g. $Fe_2O_3 \longrightarrow 4FeO + O_2$

SOLUTION

Water is the most important chemical weathering agent in most kinds of rocks through its solvent action when it dissolves water solvent minerals of rocks, it participates actively in weathering.

CARBONATION

Water and carbondioxide combine to form a weak carbonic acid which reacts with oxides of calcium and magnesium to form carbonate and bi-carbonates.

$CO_2(g) + H_2O(l) \longrightarrow H_2CO_3(aq)$

BIOLOGICAL WEATHERING

This is the weathering which is influenced by living organisms like bacteria, fungi, nematodes, lichens and mosses. A part from decomposing dead animals and plants to form soil, they produce acids which act on rock minerals and weaken it.

FACTORS AFFECTING SOIL FORMATION

CLIMATE

- The development of soil profile is largely controlled by temperature and precipitation (rainfall). Enough moisture in the soil encourages micro organisms to carry out decomposition while in the soil.
- It influences vegetation and therefore type of soils formed.
- High temperatures discourage microbial activities of organism in the soil.
- Varying environmental temperature can cause breaking up of rocks to form soil.

LIVING ORGANISMS

- Living organisms like bacteria and fungi carry out decomposition of dead plants and animals remain leading to soil formation.
- The termites are able to convert wood into soil because they have the cellulose enzymes in their guts which act on cellulose in wood.
- The vegetative cover protects the soil surface from soil erosion hence minimizing soil loss.
- Living organisms die and decompose to form soil
- Leaves from trees fall and provide organic matter
- Earth worms grind up mineral particles important in soil formation

PARENT MATERIAL

The main features of the parent materials here are texture, chemical and mineral composition of the soil.

Soils developing from limestone are usually fine textured and higher in inorganic matter than those formed from coarse textured material.

TOPOGRAPHY (RELIEF)

- This influences the amount of rainfall received in an area,
- Surface erosion which determines soil depth by removal and deposition of soil
- Water infiltration into the soil.
- It also influences vegetation through its influence on rainfall hence affecting soil formation.

TIME

It requires a lot of time for a soil to develop up to full maturity. A mature soil will contain all the required nutrients needed by plants. Conditions which speed up soil formation are; warm humid climate, flat topography and forest vegetation. The factor slowing down soil formation is cold or hot day climate, grass vegetation, slopping topography.

HUMAN INFLUENCE.

Humans tend to disrupt soil formation through disturbing soil profiles during the construction of buildings, roads and dams. Their practice of bush burning destroys organic matter and raises soil temperature, slowing down the process of soil formation.

Man can transform soil in the following ways;

- Natural vegetation is destroyed in getting land for agriculture
- Fertilizer application interferes with the chemical nature of soil
- Topography is altered through constructions of roads and buildings
- Application of pesticides changes chemical soil properties
- Soil cultivation destroys soil structure

- Irrigation may interfere with soil nutrient composition and structures

Soil formation involves 3 stages of disintegration, decomposition and translocation.

Disintegration; breaking up of parent material

Decomposition; process of decomposing organic materials

Translocation; removal of soil or vertical movement of particles and dissolved solids with in a profile and often into the ground

Soil profile

This is the vertical section of the soil through all its horizons/layers and down to the parent material

Top soil/A horizon

It's darker in colour because of high organic matter accumulation

It's an area of eluviations as plant nutrients are removed by leaching

Its more subject to weathering and cultivation operations

Its well aerated and has active micro organisms

The dark colour is mainly due to organic matter in soil

Subsoil / horizon B

It's a zone of illuviation as materials from top soil are deposited here

It's more compact than top soil

It's less aerated

Hard pans are mainly found in this region

In young soil, the B horizon is absent

The brown colour is due to the iron oxides in this horizon

Parent material /Horizon C

Contains broken down rocks

It has clay material

Zonal soils is one where climate and vegetation have played part in formation

Azonal is produced by deposition of material and without a soil profile

Intrazonal soils are formed basing on parent material

a. Podzol profile
b. Ferralsol profile.

A podzol profile displays sharp contrast between the horizons and its widely distributed in humid temperate areas.

Ferralsol: It is an example of soil that has developed under humid tropical conditions through progressive weathering of rock.

N.B. Soil catena is the sequence of soil developed from a similar parent rock material under similar climatic conditions but whose x-tics differs due to difference in relief and drainage

PROPERTIES OF SOIL

These include soil drainage, water holding capacity, plasticity, aeration, fertility, structure, density texture, porosity, colour, soil fauna, PH, and productivity.

SOIL TEXTURE

This is the proportion of sand, silt, and clay in a particular soil. Soil texture affects the following:-

a. The circulation of air in the soil (soil aeration)
In fine textured soils, there is limited movement of air due to the small spaces.

b. Water holding capacity,
This is higher in fine textured soils like clay than coarse textured soil like sand.

c. Root penetration
This is higher in coarse textured soils and lower in fine textured soils since the fine particles resist root penetration.

d. Response of plants to fertilizers
Poor root penetration means limited response to fertilizers hence fine textured soils are not good when it comes to movement of nutrients.

e. Rate of chemical reaction in the soil
Poor textured soils would limit soil reaction like carbonation, hydration and hydrolysis.

Soil	**Appearance of particles**	**Behavior when moist**	**Feeling**
Sand	Loose and single grained	No ribbon formed Not plastic	gritty
Loam	Soft clods	Weak ribbon formed Slightly plastic	Gritty
Clay	Hard lumps and highly cemented	Long flexible ribbon Formed Highly plastic	Smooth

Resistance to crushing

Loose; separate and non- coherent soil particles

Friable; lumps that can be crushed into small crumbs with gentle pressure

Compact; dense lumps of soil that can be crushed with a lot of difficulty

Slightly compact; lumps that can be crushed into fragment with moderate pressure

Cemented; soil materials that cannot be broken in hand

Plastic; soil that can be moulded when wet without breaking

SOIL TEXTURAL CLASSES

This is done according to the United States Department of Agriculture and the international soil science system.

USDA classification

Soil separate	Particle diameter (mm)
Very course sand	2.00 – 1.00
Course sand	1.00 – 0.50
Medium sand	0.50 – 0.25
Fine sand	0.25 – 0.10
Very fine sand	0.10 – 0.05
Silt	0.05 – 0.002
Clay	below 0.002

SOIL TEXTURAL CLASSES (SOIL TYPES)

There are three main textual classes (types) i.e. clay soil, Sandy soil and loam soil.

These three, give rise to other classes depending on the percentage of sand silt and clay present in a particular soil e.g. sandy clay, clay loam, silty clay loam, sandy clay loam, loamy clay sand and silty clay.

PROPERTIES OF TEXTUAL CLASSES

CLAY SOIL

- It has a high water holding capacity
- It has a high nutrient holding capacity.
- It has small air spaces
- It is not gritty
- It is not smooth
- It forms extremely cohesive balls and long threads which bend into rings easily when wetted.

SANDY SOIL

- It is extremely gritty
- It is not smooth
- Its not plastic
- It forms non- cohesive balls which collapse easily
- It has a low water nutrient holding capacity
- It has big air spaces
- It has big soil particles.

LOAM SOIL

- It is moderately gritty
- It is slightly smooth
- It is slightly sticky
- It is slightly plastic
- It forms moderately cohesive balls
- It forms long threads which bend into rings with difficulty.

- It has a moderate water holding capacity
- It contains 5 – 10% organic matter
- Loam soil is an optimum mixture of sand, silt and clay.

Experiment to determine the different sizes of particles present in the soil:-

- Place 40g of soil in 100cm3 measuring cylinder
- Fill the cylinder with water up to ¾ of it
- Cover the open end firmly with land and shake the content of the cylinder vigorously
- Stand the cylinder on a land flat surface and observe how the suspension settles down.

Results

- Some bubble escape from the container indicating the presence of air.
- After shaking, the largest particles fall to the bottom (sand) followed by fine sand, silt, clay and finally organic matter.

BULK DENSITY

This is the mass per unit volume of un disturbed soil dried to consistent weight at 105^0C. Bulk density = $\frac{\text{weight of oven dry soil (g)}}{\text{The volume of the oven dry soil (cm}^3\text{)}}$.

This property affects
Water holding capacity
Soil aeration
Crop root development
Seed germination

PARTICLE DENSITY

It's the ratio of weight of solids to volume of solids in soil g/cm^3. the solids in soil are organic matter, inorganic matter, and living organism. In the calculation of particle density, volume of air should be excluded.

SOIL PLASTICITY

This is the capacity of the soil to be molded without breaking or rupturing.

The terms used in describing the degree of plasticity are non plastic, slightly plastic, plastic and very plastic.

SOIL CONSISTENCY

This is the degree of cohesion of soil or the resistance of the soil to deformation is measured by filling and manipulating the soil by hand or pulling tillage equipment through it. The classes of consistence include:-

SOIL POSOSITY

This is the measure of the size of pore space in soils. In soils where the particles are closely together, there is limited pore space and therefore less air in such soils and poor plant root development.

SOIL STRUCTURE

This is the arrangement or grouping of soil particle in a particular soil. Soil structure affects water movement, heat transfer, aeration, bulk density and porosity.

TYPES OF SOIL STRUCTURE

i. Platy structure.

Here the soil aggregates are arranged in a relatively thin horizontal plates or leaflets. This type of structure is more common in the surface layer of virgin soils.

ii. Prismatic structure.

This includes columnar type and prismatic type. Both types are usually found in sub soils in arid and semi arid regions.

iii. Blocky structure.

This structure has two sub-structures like cube like and sub angular in heavy sub soils particularly those of humid soils.

iv. Spheroidal structure

This consists of sub-structures like granular where the aggregates are porous and crumb where the aggregates are very porous.

v. Crumb structure

This is commonly found in top soil and particles are granulated

SOIL FERTILITY.

This is the ability of the soil to supply plant nutrients in adequate amount and right proportion for better plant growth.

FACTORS AFFECTING SOIL FERTILITY.

Soil depth, soil structure, soil drainage, soil PH, soil aeration, water holding capacity, availability of plant nutrients, presence of pests and diseases, soil compaction, living organisms, accumulation of salts, soil capillarity, hard pans, soil capping and presence of polyethene materials in soil.

SOIL DEPTH

Soil depth is associated with the maturity of the soil and it also influences the amount of water retained in it for plant use.

SOIL STRUCTURE

This affects the amount and movement of air and water within the soil and also the transfer of heat. Therefore a good soil structure gives ideal conditions for plant growth.

SOIL DRAINAGE

This refers to the ease with which excess water drains out of the water logged soils. There is poor aeration, low temperature, poor soil structure, and low PH in water logged soils. All the above will interfere with normal crop growth.

SOIL AERATION

Adequate air in the soil particularly oxygen improved water and nutrients uptake and also encourages better root development. The air is also needed by the soil organisms during the decomposition of plant or animal remains.

POLYETHENE MATERIALS IN SOIL

Affects soil aeration, root development and water infiltration which all affect soil fertility

SOIL CAPPING

This affects soil drainage which determines pest attack, soil Ph and root development in crops and hence soil fertility.

HARD PANS

This impedes water infiltration hence affecting soil fertility.

AVAILABILITY OF PLANT NUTRIENTS

Plant nutrients are needed by plants and therefore a soil which contains most of the nutrients and can easily supply them is said to be fertile.

SOIL PH (SOIL REACTION)

This is the acidity or alkalinity of the soil. It influences the (ability) availability of plant nutrients e.g. at lower PH (acidic) phosphorous and molybdenum are not available but iron, Mg, Zn, K and Boron are available yet unavailable again at high PH (alkaline)

IMPORTANCE OF SOIL PH.

- It affects the presence of certain plant pathogens like bacteria and fungi are not common at low PH but fungi are common
- At very low PH the concentration of certain nutrients such as iron and Aluminium in the soil becomes toxic to plants.
- Soil PH has a strong influence on the availability of various plant nutrients.
- Very low or very high PH inhibits the activity of the soil micro-organisms more especially the nitrifying bacteria.

TESTING FOR SOIL PH

Place a sample of soil in a dry test tube

Add barium Sulphate/ ammonium Sulphate to the soil sample

Add distilled water to the mixture and shake gently

Add 3 drops of the universal indicator and allow the contents to settle for about 45 minutes

Use the Ph chart to find the ph of the soil by relating with the colour of the contents in the test tube

ACIDITY IN SOILS.

This is caused by the following: -

- Soil formed from acid rocks: Rocks such as granite contain an excess of silica (Quartz) which combine with water to form acids.
- Presence of humus: Humus may react with iron and aluminum to form complexes which under go hydrolysis to yield hydrogen ions responsible for acidity.
- Presence of soluble salts: These may be acidic, neutral, or basic arising from fertilizers mainly.
- Water lodging: This causes hydrolysis of some of cautions in the soil which may release hydrogen ions leading to soil acidity
- Rain water: atmospheric carbondioxide combines with rain water to form a weak carbonic acid responsible for soil acidity.
- Cultivation of crops: The growing of crops can cause acidity when the plant absorbs cations that can be replaced by hydrogen ions.
- Fertilizers application: Application of fertilizers increases cations and anions content in the soil. When the nitrates are leached they move along with cations leaving the H^+ behind
- Biological activities in the soil: Anaerobic decomposition of organic matter leads to formation of weak acids in the soil e.g. lactic acids, ethanoic acids (Organic acids)
- The presence of sulphides in the soil: The sulphides in the soil can also cause soil acidity due to the production of H^+ ions.
- Presence of sulphides: These can cause acidity to the production of H^+

SOIL AMMENDMENT

Rising of the soil PH to reaction nearer neutral is done by addition of lime a process called liming.

Liming materials:-

- Calcium carbonate (lime)
- Calcium Sulphate
- Calcium carbonate
- Magnesium carbonate.
- Wood ash
- Sugar factory lime
- Calcium hydroxide
- Calcium magnesium carbonate

Factors considered before liming

- Soil ph; very high or low ph may require amending
- Buffer capacity of the soil i.e. ability to resist change in ph after addition of lime
- Amount of bases in the exchange complex.

- Type of crops to be grown i.e. each crop requires a different ph
- Fineness of the materials to be used for liming
- Amount of manganese present in the soil

Benefits / Importance of liming:-

- It increases the use of nutrients by crops leading to increased yields.
- It increases the microbial activity in the soil
- Organic matter decomposition in the soil is accelerated
- It increases the availability of plant nutrient and their supply like phosphates.
- Make soils easy to cultivate more especially clay soil
- Ensures sufficient utilization of soluble acidic manures such as phosphates
- Keeps the soil in good condition for crop growth.

Negative effects of liming

- It can lower the yields of crops in later years if the PH is allowed to increase continuously.
- It is expensive therefore can increase the production.
- It decreases the future supply of plant nutrients
- Accelerated organic matter (OM) decomposition causes a decline in organic matter content of the soil.

Characteristics of a good liming material

- It should have a mild alkanising effect
- It should have a favouable effect on soil
- Should be cheap and readily available
- Should not affect soil microbes
- Should not affect availability of crop nutrients

LOSS OF SOIL FERTILITY

Soil can loose fertility through:-

Soil capping
Change of soil PH
Build up of pests and diseases in the soil
Burning
Formation of hard pans
Soil erosion
Over cultivation
Crop removal during harvesting
Large number of weeds.

Soil Capping

This is the formation of an impervious layer on the surface of soil which prevents water infiltration. This stops the dissolution of plant nutrients and proper root development

Formation of Hard Pans

This is an impervious layer formed just beneath the soil surface and can be caused by continuous ploughing at the same depth. It prevents water percolation and proper crop root development.

Over cultivation

This causes rapid oxidation of organic matter by micro organisms leading to loss of fertility.

Effects of over cultivation of arable land

- Destroys Soil structure making the land more prone to erosion
- Increases production costs by engaging more labour in cultivation
- Can destroy crop roots
- Can increase evaporation of moisture from soil by increasing surface area for water loss.
- Increases oxidation of crop nutrient hence loss of fertility

Crop removal during harvesting

The removal of crops from the garden or their products from the garden carries away all the nutrients concentrated in their tissue and seeds.

Weeds over growth

These use a lot of nutrients and therefore cause loss of nutrients from the soil

Leaching

This is the washing out of soil nutrients in both solution and suspension to the deeper layers of the soil where plants can not utilize it.

Soil erosion

This carries away the more productive top layer of soil leading to loss of fertility

Change of soil PH

Some plants nutrients are available at low PH e.g. iron, Mg, A1, Zn, K and Boron while others are favoured by a high PH e.g. phosphorous and molybdenum

Buildup of pests and diseases

This may be caused by mono-cropping and therefore less products expected from such a soil.

MAINTAINANCE OF SOIL FERTILITY

The fertility of the soil can be maintained through the following ways:-

1. **Crop rotation:** Is the growing of different crops on the same piece of land in a particular sequence season after season for proper utilization of nutrients

   Follow the guide lines.

- Legumes should alternate with other crops since they increase soil fertility by fixing nitrogen
- Crops with high nutrient requirement should come first on a newly cultivated piece of land to utilize a high content of nutrients present at this stage.
- Deep rooted crops should alternate with the shallow rooted crops since deep rooters bring nutrients to the upper layers of soil for shallow rooters to use
- Cover crops should be included in the rotation to control erosion.
- A fallow period should be included in the rotation to preserve soil structure and restore the lost nutrients.
- Crops that are easy to weed should alternate with those that are difficult to weed.
- Crops attacked by similar pests and diseases should not succeed one another in the rotation to reduce spread

Importance of crop rotation

- There is maximum use of soil nutrients since different crops with different nutrients requirements are involve in the rotation.
- Pests and diseases are easily controlled by breaking their cycle and starvation.
- Parasitic weeds like *string spp* in sorghum are easily controlled under crop rotation.
- The nitrogen content of the soil can be improved more especially if legumes are included in the rotation.
- Good rotation evens out Labour requirement throughout the year.
- It spreads financial risks over several crops
- Some deep-rooted crops in the rotation will recycle nutrients.
- Soil erosion can be controlled during the fallow period when grasses are allowed to grow on the land or by the binding action of the plant roots.

An example of a four-year crop rotation

Year	Plot 1	Plot 2	Plot 3	Plot 4
1	Sweet potatoes	Beans	Cassava	Millet
2	Millet	Sweet potatoes	Beans	Cassava
3	Cassava	Millet	Sweet potatoes	Beans
4	Beans	Cassava	Millet	Sweet potatoes
	Fallow	Fallow	Fallow	Fallow

NB After the fourth year the farmer can decide to have a fallow period

Limitations of crop rotation

Shortage of land due to an increasing human population

Presence of permanent building that cannot be rotated

Introduction of perennial crops with a long gestation period

Merits of the practice cannot be easily recognized by farmers hence difficult to convince them

2. **Proper weed control**: weeds compete with crops for soil nutrients. A high population of weeds will extract a lot of nutrients from the soil making it infertile in the long run.
3. **Mulching**: Is the covering of top soil with dry plant materials or artificial substances like polythene papers. Apart from conserving the soil moisture and suppressing weeds, mulches also rot and add fertility to the soil.
4. **Minimum tillage**: Minimum disturbance of the soil will conserve its organic matter content and moisture hence maintaining fertility.
5. **Soil pH control**: At different pH some macro and micro elements are present while others are absent. The soil pH can be maintained through liming and addition of fertilizers.
6. **Addition of manure**: The addition of both organic and inorganic manure will increase the amount of soil nutrients therefore maintaining the fertility. However, over use of artificial manure can cause acidic conditions in the soil that may lower soil fertility.
7. **Soil erosion control**: The washing away of he most fertile top soil leads to loss of soil fertility as well. Methods of controlling soil erosion like terracing, mulching, contour ploughing etc should be used.
8. **Improving on soil drainage**: This will eliminate water logging with all its disadvantages like increased leaching
9. **Improving on the water holding capacity of the soil**: Water is needed by plants in the absorption of soil nutrients and in photosynthesis therefore water holding capacity of the soil should be improved to maintain the soil fertility through the addition of organic manures.

COMPONENTS OF SOIL

Soil is composed of living organisms (micro and Macro), air, mineral elements, organic matter and water.

Living organisms

These include micro organisms like bacteria, fungi, protozoa, etc. It also includes macro living organisms like earth worms and some insects.

Importance:

- They carry out decomposition of dead plants and animals remains to produce humus which is used by plants.
- Some bacteria like Rhizobia fix nitrogen into the soil
- After their death more especially the macro organisms decompose and add fertility to the soil.
- Other living organisms like earthworms, excrete urea which adds fertility to the soil by providing nitrogen.
- They aerate the soil by making tunnels. The more tunnels, the more the aeration.

AN EXPERIMENT TO SHOW THAT SOIL CONTAINS LIVING ORGANISMS.

Apparatus

- 2 conical flasks
- Lime water

- 2 muslin bags
- 2 samples of soil i.e. sample A sterilized soil and sample B fresh top soil.

Procedure

Label the conical flasks i.e. A and B
Pour about 10cm3 of lime water in each of the flasks.
Put fresh top soil in the muslin bag and hung it in the conical flask A and sterilized top soil in another muslin bag in B as shown below.

Observation:

After 8 hours the lime water in flask A will turn milky while in flask B there will be no observable change.

Conclusion

The lime water in flask A turned milky due to the presence of living organism in the soil that respire releasing carbondioxide which turns lime water milky.

SOIL AIR

Soil contains air, the biggest portion being CO_2 and O_2. Soil air is used by living organisms in respiration and also the plant roots.

N.B. Water and air occupy the same position and therefore high level of water in the soil will reduce the amount of air in that particular soil.

Apparatus:

Soil sample
Distilled water
A beaker
Stirring rod

Procedure

Put the dry soil sample in the beaker to cover ¼ of it.
Pour twice the volume of soil water, and stir continuously

Observation

Air bubbles are seen coming out of the water in the beaker

Dry soil contains air.

EXPERIMENT TO DETERMINE THE AMOUNT OF AIR IN SOIL

Apparatus:

Dry soil sample
At least two measuring cylinders
Distilled water
A beaker.

Procedure:

Measure off 50cm^3 of dry soil and transfer to another dry measuring cylinder.

Measure off 50cm^3 of water and add it to the soil in the measuring cylinder.

Observation

Bubbles of air are seen escaping when the two are added and the volume of the mixture is less than the expected 100cm^3.

Conclusion:

The difference between the expected volume of the mixture (100cm^3) and the actual- volume will be that of air e.g. (50 + 50) cm^3 = 100cm3 expected.

Actual = 70cm^3
100 – 70 = 30cm^3 Air = 30cm^3

EXPERIMENT TO DETERMINE WHETHER SOIL CONTAINS WATER

Apparatus

Dry soil sample
Boiling test tube
Heat source
Stirring rod.

Procedure

Pour dry soil up to 1/3 of the test tube.
Put the test tube on a heat source for about 5minutes.

Observation:

As the heating goes on, vapour condenses at the cooler part of the test tube.

Conclusion

Soil contains water.

SOIL PERMEABILITY.

This is extent to which a soil allows water to pass and spread through it. However sometimes soil permeability and soil drainage are considered to be the same.

Soil drainage

Refers to the relative ease by which water passes through the soil.

EXPERIMENT TO SHOW WATER RETENTION (DRAINAGE) IN SOIL

Apparatus

Atleast 3 filter funnels
Filter paper / cotton wool
Three soil samples i.e. clay, sand, and loam
Clean water
Stop clock
Atleast three measuring cylinders
Arrange the practical as below:-

Water should be added to each of the funnels in the same quantities. A stop clock should be used to measure the time taken for a particular quantity of water to pass through each sample.

Observation:

After a specific period of time its observed that clay soil retains a lot of water than loam and sandy soils. Therefore, clay soil is poorly drained while sandy soil is well drained.

EXPERIMENT TO FIND OUT THE AMOUNT OF ORGANIC MATTER IN THE SOIL

Apparatus needed

Heat source	evaporating dish	Tippled stand
Weighing balance	Stop Clock	Stirring rod
Soil sample		

Procedure

Weigh the evaporating dish and its weight recorded as X g

Weigh a dry sample of soil and call it W g.
Add the two weights and the total should be called "y" i.e. (CX+W) g = Yg.
Place the dish with the soil on heat source for about 30 minutes.
Remove the dish after that time and cool it.
Weigh the dish and the soil and call it Zg
The weight of organic matter in soil = Yg-Zg =P g
Pg is the loss in weight as a result of loss due to organic matter.

SOIL PRODUCTIVITY.

This refers to the ability of the soil to produce and sustain high crop yields.

CHARACTERISTICS OF PRODUCTIVE SOIL

- It should be well drained.
- It should be of a sufficient depth for good root penetration and growth.
- It should be well aerated.
- It should have a good water holding capacity.
- It should have enough nutrients which must be the right proportions.
- It should be fee from crop pests and diseases.
- It should have a right PH for the particular crop to be grown on it.
- It should have a good structure and texture.

PLANT NUTRIENTS

Plant nutrients can be divided into two major groups i.e. Macro and Micro nutrients.

Macro nutrients (major elements)

These are nutrients needed by plants in large quantities e.g. carbon, oxygen, hydrogen, nitrogen, phosphorous, potassium, calcium, magnesium and Sulphur.

Micro elements (trace elements)

These are nutrients needed by plants in small quantities though they are very important for plant growth. E.g. iron, manganese, copper, molybdenum, zinc, chlorides and cobalt.

Macro nutrients

Nitrogen:

This is one of the most important elements needed by plants yet its deficient in most areas of East Africa.

Uses of nitrogen to plants

- Its necessary for the formation of chlorophyll
- It improves the quality and quantity of leaf crops such as cabbages, dodo, etc.
- It is a constituent of plant proteins.
- It helps in cell division and therefore responsible for growth
- Controls the use of phosphorus and potassium in the plants.

Deficiency symptoms of Nitrogen in plants.

- There is restricted root development
- Plants become stunted.
- There is even yellowing and loss of leaves
- There is pre-mature ripening of fruits.

Signs of excess nitrogen in plants.

- Excessive leaf production
- Delayed maturity
- Leaf and stem logging
- Scotching of leaves
- Poor crop yields

Fate /loss of nitrogen from the soil

- Crop removal during harvesting
- Soil erosion.
- Through leaching
- Burning of crop residues
- Volatilization (denitrification; oxidation of nitrates to atmospheric nitrogen)

Sources of nitrogen

Commercial fertilizers e.g. NPK, Urea, CAN, Sulphate of ammonia, Diammonium phosphate (DAP)

Organic fertilizers like farm yard manure, compost manure and green manure.

Lightening.

PHOSPHOROUS

Importance

- Encourages the formation, development and establishment of roots.
- It is necessary in the formation of fruits and seeds.
- It is needed for cell division
- Production of fats and proteins.
- It helps in nitrogen break-down during respiration
- It is a constituent of nucleic acid (DNA, RNA)
- It is important in the synthesis of nucleoprotein
- It is a constituent of phospholipids.
- It gives resistance to certain diseases in crops.
- Its essential part of all the sugar phosphate in photosynthesis and other metabolic processes.
- Improves the quality of crops more especially vegetables.

DEFFICIENCY SYMPTOMS

- Purple colouration of the leaf especially at the margin.
- Low yield of grains, fruit and root crops
- Slow growth rate resulting into late maturity of the crops.
- Red necrotic areas on the leaves, petioles etc.
- Distortion of the leaf shape
- Older leaves become dark brown.
- There is a general overall stunted ness and leaf fall.

POTASSIUM

Importance

- It increases resistance to certain diseases
- It encourages root development and growth
- It is necessary for formation of starch and transport of sugar within the plant.
- It is essential for chlorophyll formation.
- It is needed in nitrogen metabolism and protein synthesis.
- It reduces lodging in plants by strengthening cellulose cell wall.
- It controls stomatal movement hence loss of water.
- Its important to folic metabolism
- It has been linked with carbohydrates metabolism.
- It regulates water in plant cells.

Deficiency symptom

- Retarded root development
- Plants are easily attacked by diseases
- Leaves dry out at the edges
- Premature loss of leaves
- Chlorosis can also be experienced
- In cereals cell at the leaf tip and margin die first.
-

Factors affecting the availability of potassium in the soil

Soil moisture: Too much moisture interferes with exchangeable moisture.

Soil pH: High soil pH favours potassium fixation

Temperature: High temperature favours the level of exchangeable potassium

Types of colloids: Potassium fixation is usually done in soil containing montimolironite.

CALCIUM

Importance

- It raises soil pH which favours nitrogen fixing bacteria
- Improves root development and growth
- It improves vigor and stiffness of the stem,
- It governs the availability of certain essential minerals like phosphorus and potassium.
- It is an activator of enzymes in plants
- It is associated with cell wall structure
- In increases carbohydrates content in crops like cotton.
- It increases the number of mitochondria in wheat plants.
- It protects plants from injuries due to the effect of hydrogen ions.

Deficiency symptoms

- The roots become stunted
- Death of the leaves occurs
- Formation of weak stem
- Leaves become chlorotic and chlorosis occurs along the margin of younger leaves.
- Terminal buds and tips of roots do not grow well
- There is distortion of the growing shoot tip
- Cell walls become rigid and brittle

Sources:

- Crop residues
- Manure i.e. organic and inorganic
- Weathering of sol minerals
- Agricultural lime (Calcium Carbonate, $CaCO_3$)

MAGNESIUM

Importance

- It is a constituent of chlorophyll hence responsible for the green colour.
- It is important in the formation of oils in plants.
- It encourages the production and transportation of carbohydrates and proteins in growing plants.
- It maintains the integrity of chromatic fiber and ribosomes.
- It is necessary for full activity of two principle carbon dioxide fixing enzymes.

Signs of magnesium deficiency.

- Loss of green colour in leaves
- Development of purple, orange, and red patches in horticulture crops such as cabbages.
- It causes extensive chlorenchyma development and scanty pith formation.

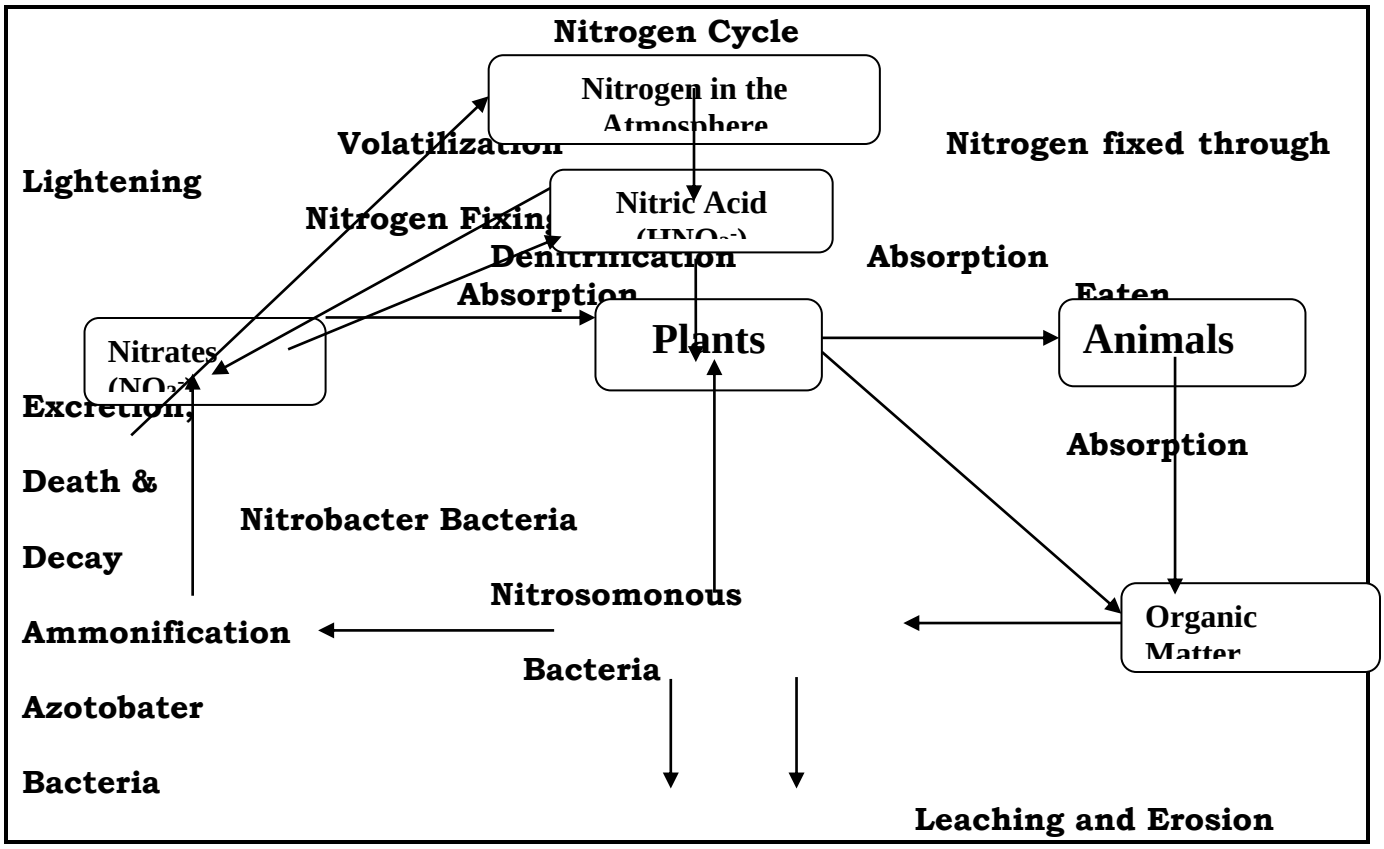
SULPHUR

Importance

- It is needed in protein synthesis as it's a component of some amino acids.
- It is used in the production and activation of some enzymes.
- It increases the oil content of crops (plants)
- It is essential in the production (formation) of some vitamins like biotine.
- Sulphur together with iron form enzymes important in photosynthesis, respiration, and nitrogen metabolism.

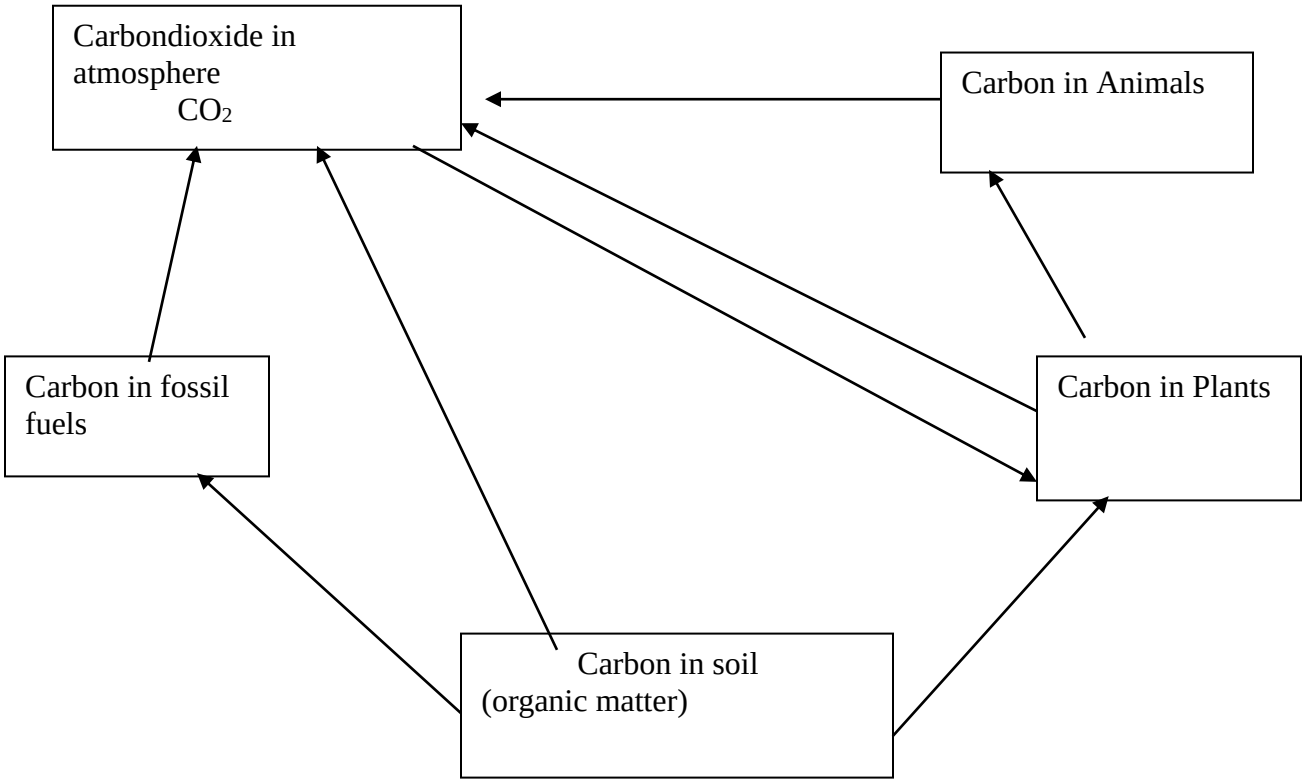
Def…om

- …nodules in legu…
  - Stems are thin and plants are extremely small and short.
  - There is complete chlorosis
  - There is rapid leaf fall
  - Leaf tips and margins are rolled inwards.
  - Terminal bud growth is inhibited and lateral buds develop pre-maturely.
  -



i) **Phosphorus (P) and its uses**

CARBON CYCLE



MANURES AND FERTILIZERS

These are substances which are either organic or inorganic that add fertility to the soil once applied.

There are two types of manures /fertilizers i.e. organic manures and inorganic manures.

Inorganic manures/fertilizers are chemical substances which are manufactured artificially to supply the chemical elements required for growth and reproduction of the plant.

ORGANIC MANURES

These are substances derived from plants or animals' products that will add fertility to the soil once applied.

Examples of organic manures: -

Farm yard manure, livestock manure or muck
Green manure
Compost manure

Importance of organic manures:

- They increase nitrogen content in soils after decomposition
- They increase the availability of plant nutrients like potassium, calcium, magnesium, and phosphorus.
- They increase the humus content in the soil after their decomposition.
- They improve the soil structure more especially in sandy soils.
- It increases the population of microbes in the soil by acting as food for such living organisms.
- Organic manures like muck can rise the soil PH
- They do not have residual effect on the soil.
- Deactivates organic pesticides
- Increases cation exchange capacity of the soil

Characteristics of organic manures

i. They are derived from plant and animal materials
ii. Contain much lower amounts of plant nutrients
iii. They improve soil structure
iv. They stimulate the rate of microbial activities
v. They are more costly to apply per unit of per unit of plant food
vi. They are not leached easily due their low solubility in water
vii. Have no residual effects on crops and soil organisms

COMPOST MANURE:

This is a mixture of decomposed crop remains, vegetable matter, weeds and kitchen refuse.

Advantages of compost manure:

- It really releases nutrients for plant growth.
- It promotes the conservation of soil moisture by lowering the rate of evaporation of water from the soil.
- Fully mature compost manure is black therefore helps in absorbing the sun's heat.
- It improves on soil structure more especially in sandy soils.

- It promotes the activity of microbes in the soil by providing food for them.
- It enhances the creation of neutral reaction in the soil.

Limitations of compost (disadvantages)

- If used immediately after making, it can heat up and burn crop roots.
- It requires a lot of Labour to prepare it.
- Big volumes of compost are needed to be applied in order to obtain the required nutrients.
- There should be a good source of composting materials in order for a framer to make enough which is not always easy.
- It requires large volumes of water during processing to keep the temperatures at optimum.

METHODS OF COMPOSTING

There are two main methods i.e. Heap method and pit method.

PIT METHOD

This is when composting is done in pits dug in the ground. It is mainly applied in areas with low rainfall.

Procedure of making compost

i. Pits measuring up to 180cm in length, 120cm width and 60cm in depth varying according to the type of materials being used.

ii. Stones/ maize stalks are placed at the bottom of the pit to form a foundation and promote proper air circulation

iii. Materials for composting should be chopped into small pieces

iv. Composting materials should be arranged in the pit as follows; maize stalks/ elephant grass at the bottom 10 cm height, grass/ leaves/ weeds/ kitchen refuse 10cm height, manure (farm yard) 10cm height, wood ash 10cm height and top soil 10cm height in order.

v. Repeat the arrangement until the pit is full

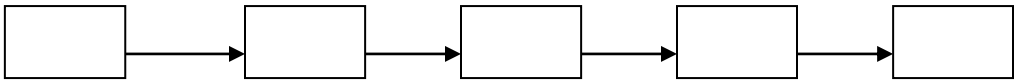
vi. Put plant leaves at the top of the pit to facilitate proper air circulation

vii. Add about 0.5 kg of ammonium Sulphate at any 0.3m height to increase nitrogen content of the compost manure.

viii. Place a stick long enough to reach to reach the bottom to monitor the temperatures

ix. Sprinkle water to the pit when the temperatures are high to maintain it at optimum

x. Turning of the material in pits should be done every after 2 to 3 weeks to enhance complete decomposition as follows;



xi. Materials in pit A are put in pit B and pit A filled with fresh materials

xii. After 2 to 3 weeks materials in B is turned to pit C and replaced with that in pit A

xiii. Materials are changed every after 2 to 3 weeks in the order until there is complete decomposition

xiv. This type of sequence ensures continuous supply of manure to the garden

Heap/ stack method

This is done in areas with high rain fall

Procedure of making compost

i. Select a flat area with a good drainage

ii. Make stacks/ heaps of about 1.5 to 2 m squared and 1 m away from each other.

iii. Materials for composting should be chopped into small pieces

iv. Composting materials should be arranged in the pit as follows; maize stalks/ elephant grass at the bottom 10 cm height, grass/ leaves/ weeds/ kitchen refuse 10cm height, manure (farm yard) 10cm height, wood ash 10cm height and top soil 10cm height in order.

v. Repeat the arrangement until the heap/ stack is full

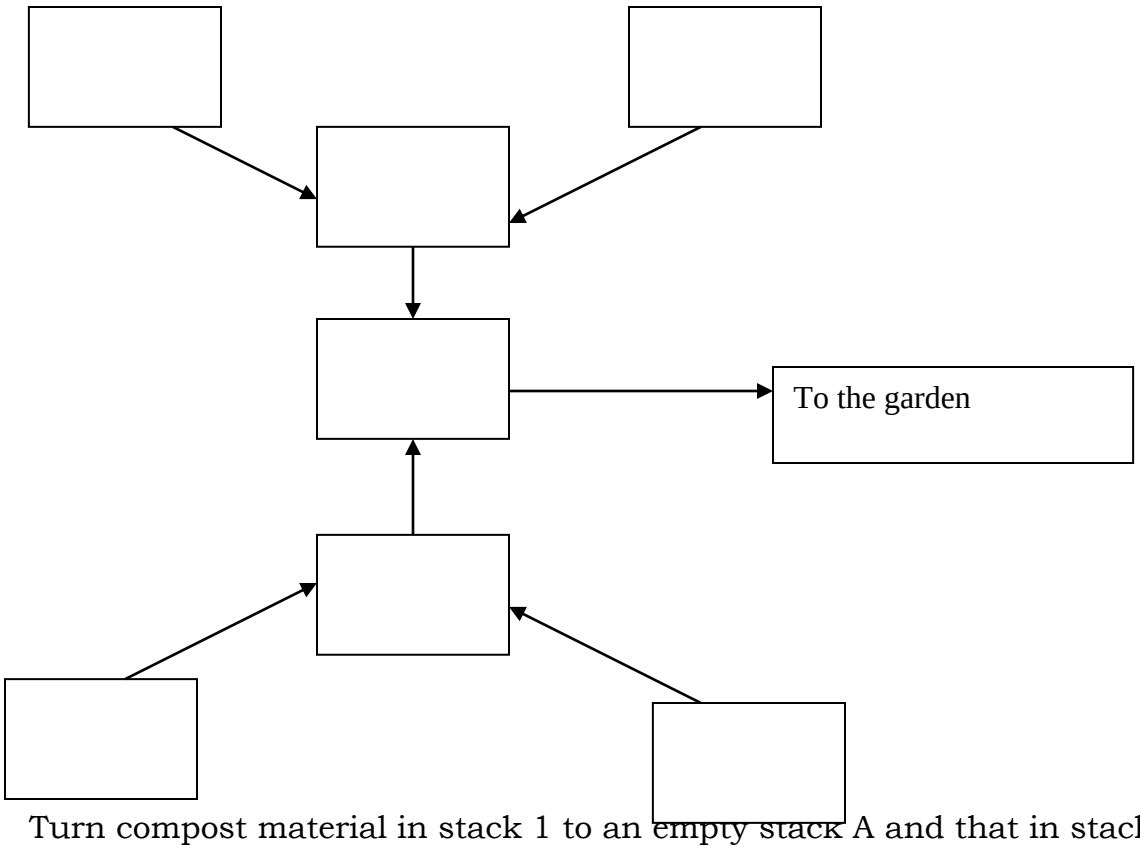
vi. Put plant leaves at the top of the heap/ stack to facilitate proper air circulation

vii. Add about 0.5 kg of ammonium Sulphate at any 0.3m height to increase nitrogen content of the compost manure.

viii. Place a stick long enough to reach to reach the bottom to monitor the temperatures

ix. Sprinkle water to the heap/ stack when the temperatures are high to maintain it at optimum

x. Turning of the material in heaps should be done every after 2 to 3 weeks to enhance complete decomposition as follows;



xi. Turn compost material in stack 1 to an empty stack A and that in stack 2 on top of 1 in A after 3 weeks.
xii. Turn compost material in stack 3 to an empty stack C and that in stack 4 on top of 3 in C after 3 weeks.
xiii. Empty stacks should be refilled with fresh composting material to ensure continuous supply of compost on the farm.
xiv. Turn material in stack A into stack B then followed by that from C after about 7 days
xv. Leave the materials in stack B until decomposition is complete

Precautions to take when preparing compost manure

i. Make stacks/ heaps that are neither too small nor too big to avoid incomplete decomposition
ii. Ensure free air supply to the compost container for proper decomposition
iii. Avoid putting sticks and plastics in compost materials since they reduce quality
iv. Sprinkle enough water to maintain temperature good for proper decomposition
v. Occasionally turn the materials to ensure proper decomposition
vi. Add thin layers of farm yard manure to improve the quality of compost manure
vii. Do not trap flies in compost material during composting since it may lower quality

viii. Place compost pit or heaps in areas sheltered from sun's heat and wind.

GREEN MANURE

This is the manure made by incorporating green and vigorously growing plants into the soil.

X-teristics of a good green manure plant:-

- It should be able to grow very fast so as to meet the required purpose in time.
- It should have high nitrogen content.
- It should be leafy or highly vegetative.
- It should be able to rot rapidly and provide manure.
- It should be disease and pest free.
- It should be easy to plough into the soil.

Advantages of green manure:

- It supplies Organic matter to the soil which can improve soil structure.
- It adds nitrogen to the soil especially when legumes are used.
- It stimulates bio-chemical activities in the soil
- It assists in conserving and making available plant nutrients.
- It increases yields more especially in maize, by 20% -70%.

Limitations of using green manure:

- Potential crops for green manure are food crops therefore its difficult to convince farmers to practice it that way.
- Machinery is needed to incorporate the plant into the soil which may not be readily available.
- Old plants with high fiber content are very difficult to plough into the soil.
- If the crops are left to grow until they are hard and fibrous, they may not decompose easily.

FARM YARD MANURE (MUCK, LIVESTOCK MANURE)

This is manure consisting of fermented dung and urine of animals mixed with rotten vegetable matter.

Importance of farm yard manure:

- It adds large quantities of organic matter to the soil.
- It provides the soil with essential nutrients like NPK (Nitrogen, Phosphorus & Potassium).
- It can be used to improve the quality of other organic manures such as compost.

Preparation of farm yard manure

- Place dry litter in the animals' pen to act as bedding
- Turn the litter as animals defecate and urinate on it
- Select a flat place with a concrete floor out side the pen

- Remove the dirty litter from the pen and place it on the concrete floor
- Raise a shade over the litter collected from the pen to protect it from rain and sun shine
- Allow the contents to decompose completely while in the shade
- Coat the content with a thin layer of top soil to reduce loss of nitrogen
- After six weeks the manure is ready for use

N.B Farm yard manure should be prepared under cover to prevent losses of nitrogen and soluble mineral nutrients.

Factors affecting the quality of farm yard manure: -

1. The type of animals that provides dung; Non- ruminants and fattening animals produce dung rich in nutrients than that of lactating animals which extract a lot of phosphorous from the feeds.
2. Type of food the animal eats; Feeds that are rich proteins and minerals tend to produce better quality dung for manure.
3. The type of beddings (litter) used by the animals; Cereal straw has a higher capacity of absorbing moisture therefore can make a better raw-material for manure.
4. Method of storage: Manure heaps should be sheltered from direct sunshine and rain since rain leaches away nutrients.
5. Length of time given for complete decomposition; The more time given for complete decomposition, the higher the quality of the manure.

INORGANIC MANURES

These are chemical substances which are manufactured artificially to supply the chemical elements required for growth and reproductive ness of plants.

TYPES OF INORGANIC MANURES

There are two main types of inorganic fertilizers

i. Straight fertilizers
ii. Mixed /Compound fertilizers.

STRAIGHT FERTILIZERS

These supply only one of the primary macro nutrients (nitrogen, phosphorus and potassium) e.g urea, single super phosphate, double super phosphate, Sulphate of ammonia, calcium-ammonium nitrate and ammonium nitrate.

MIXED/ COMPOUND FERTILIZERS

These contain atleast two of the primary macro-nutrients (elements) of Nitrogen, Phosphorous and Potassium (NPK). Examples of such fertilizers are N.P.K., Di-ammonium phosphate, ammonium hydrogen phosphate etc.

Advantages of Compound Fertilizers

The mixture is usually dried into fine and well-mixed granules which can be applied by hand and through fertilizer drill.

The mixture is stable and does not cake up to form lamps

They contain all the major plant nutrients in right proportions.

They save the farmer's Labour of mixing fertilizers during application.

Disadvantages (Limitations)

They are slightly more expensive than straight manures.

They may be unsuitable for most of the soils which lack only one nutrient.

FACTORS INFLUENCING (DETERMINING) THE USE OF MANURES BY FARMERS:

- Soil analysis: This is important because it expresses the need and type of fertilizers
- The types of fertilizers available; Different crops require specific nutrients and therefore the fertilizers available in shops should meet the above.
- Price of a fertilizer, increases use of fertilizers by farmers is determined by the prices and the expected profits after use.
- Management; The farmer's follow-up of the right application method and period of application affects the results achieved after use.
- Knowledge and skills of the farmer; Farmers more informed about fertilizers can use more of it
- Crop value; growing low value crops may not encourage the use of fertilizers since the cost may be higher than the yield expected

FACTORS AFFECTING CROP RESPONSE TO FERTILIZERS

i. Nature of fertilizers; Highly soluble fertilizers can be easily absorbed and used by crops
ii. Soil factors; Some soils have a higher ability of supplying nutrients than others and it varies from place to place and time to time
iii. Climate; Places with low rainfall have reduced leaching hence most of the fertilizers applied will be used by crops
iv. The rate of application; Some fertilizers once applied in excess will become toxic and hence not used by the crops or cause death to the crops
v. Crop factor; Some crop will fail to respond to a particular fertilizer hence making it useless crops will need a higher quantity of the fertilizers to respond.
vi. Crop age ; Mature crops may have low fertilizer requirement than the young vigorously growing crops
vii. Presence of pests and diseases; Crops attacked by such shoe a low response to, fertilizers due to a compromised crop physiology
viii. Weed population; A high population of weed in the garden will use a lot of nutrients leaving little for the crop hence low crop response
ix. Soil structure; Poor structure prevents proper root development hence a reduced nutrient absorptive power for crop roots.

APPLICATION OF FERTILIZERS TO THE SOIL:

The methods for supplying fertilizers efficiently are:-

1. **Broadcasting** before planting: Here the fertilizer is spread uniformly over the field and it gives positive results for seeds which are broadcasted.
2. **Row or band placement**; In this method, the fertilizers are placed in localized areas along the rows at calculated distance for maximum absorption by plants.
3. **Top dressing;** The fertilizers more especially nitrogenous is applied as a second dose by broadcasting on the soil surface close to the plants when the crop is 3-4 weeks old.
4. **Drill placement**; The fertilizers is applied by a drill along with the seed during planting. The method gives good results with wheat, maize and other cereals.
5. **Band placement;** The fertilizer is placed on one side or both sides of the row about 5cm below the seed and 4cm from the plant. The method is useful for crops which are sensitive to direct contact with fertilizers like cotton and tomatoes,
6. **Application by plough**: The fertilizers are placed in a continuous band at the bottom of the plough furrows. Each band is covered as the succeeding furrows are turned over.
7. **Applying liquid fertilizers by irrigation or spraying**: The application of fertilizers in solution can be used on high value crops and the fertilizer has to be soluble in water.

SOIL AND WATER CONSERVATION

This is the science and art of looking after the land in such a way that soil is retained in one place and not carried away by erosive agents.

Aims of soil and water conservation:

- To reduce soil losses by taking measures against agents that cause soil erosion.
- To maintain soil fertility that can be lost through erosion.
- To retain water essential for crop growth.
- To maintain the physical properties of soil that is ideal for crop production.

SOIL EROSION

This is the removal /washing away of top soil by wind and running water.

Factors predisposing soil to erosion: -

1. Overgrazing: Keeping a high number of grazing animals on a limited amount of pasture removes vegetation cover exposing land to erosion.
2. Burning of vegetation: this removes the vegetation from the soil exposing it to erosive agents like water and wind.
3. Over cultivation: This reduces the organic matter in the soil and also destroys soil structure making the soil more prone to erosion by running water and wind.
4. Improper farming methods: Like ploughing along the slope, planting annual crops on steep slopes encourages soil erosion.
5. Man's activities: The major activities here are those involved in construction which can lead to the clearing of vegetation.

Effects of Soil Erosion in Agriculture:

1. It reduces the quality of soil by washing away soil nutrients and increasing acidity.
2. There is a reduction of land area available for production more especially where gully erosion occurs.
3. Erosion increases the costs of production since the farmer will spend money trying to control it.
4. It destabilizes soil profiles by transferring soil from one place to another.
5. Erosion leaves the soil surface bare and hard which makes the soil more difficult to work.
6. Soil productivity is reduced more especially when less productive soil is deposited over the productive soil.
7. Gully erosion in particular makes mechanization on the affected field very difficult.
8. Erosion can lead to water pollution more especially where fertilizers from land are washed into water bodies to cause pollution of the water.
9. Erosion leads to the sedimentation of dams, rivers, and lakes.
10. Leads to spread of weed seeds.
11. It may lead to the spread of pests and diseases in gardens
12. It alters soil structure and texture that affects crop growth

TYPES OF EROSION:

Geological Erosion: This takes place under natural conditions before man's disturbance of soil and vegetation.

Accelerated Erosion: This is the deterioration and loss of soil as a result of human or animal activities which losses soil directly or indirectly.

Splash / rain drop erosion; this as a result of the impact of rain drops on the soil surface. The seriousness of this erosion depends on rain drop size, vegetative cover, soil structure and land gradient.

Sheet erosion; this is a uniform removal of layers of soil from sloping land as a result of sheet flow. It is the most serious erosion since it removes the most productive layer of soil. It gives way to rill erosion.
Rill erosion; soil is removed leading to the formation of small and clearly cut channels. Rills are small and can be removed by normal ploughing or harrowing
Gully erosion; this is where U and V shaped large channels are formed that can carry a lot of water and soil. Gullies cannot be removed by normal cultivation methods due to their size.
Wind erosion; this is where wind carries soil as it blows over the bare soil surface with no vegetation. It is more serious in places with limited vegetation and loose soil structure

Factors influencing soil erosion:

1. Rainfall intensity: Rain received in small amounts over a long period of time caused less erosion than that received in large amounts for a short time.
2. Topography: the steeper the slope, the faster the speed of water flowing over it and the greater the soil eroded. A longer slope has more water flowing over it and therefore a greater chance of erosion taking place.

3. Vegetation:
   - The density of vegetation cover affects the rate of erosion. Dense vegetation reduces soil erosion by slowing down the speed of rain water and the impact of rain drops on the soil surface.
   - The plant roots can bind soil particles reducing the chances of erosion
   - Decomposed plants add organic matter to the soil which improves the water holding capacity and soil structure that can resist erosion
   - Trees can act as wind brakes hence reducing the effect of wind erosion.
   - Vegetation increases water infiltration which reduces surface run off

4. Farming practices: Continuous cultivation of land leads to the break done of the soil structure making the soil more susceptible to erosion.
5. Ploughing down the slope will increase soil erosion since the speed up the speed of water.
6. Man's activities. Disturbance of soil structure and other properties by man may increase rate of erosion

CULTURAL METHODS OF SOIL AND WATER CONSERVATION

I. **Minimum tillage:** this safe guard against disturbance of soil physical properties thus reducing the chances of erosion and moisture loss.

Importance of minimum tillage on soil conservation

Preservers soil structure hence making soil resistant to erosion and water loss.

Reduces loss of water by evaporation.

Conserves organic matter in the soil by reducing oxidation.

II. **Mulching:** This reduces the impact of rain drops on the soil surface to cause splash erosion and also controls loss of soil moisture **Mulch** is any material used to cover the soil surface to prevent excess loss of water by evaporation, control of soil erosion and suppressing weeds.

Materials used as mulch include: -

Straws, dry leaves, trash, stalks, coffee husks, dry grass, sisal waste and polythene.

Advantages of Mulching:

- Reduces soil erosion by checking the speed of water and battering effect of rain drops on the soil surface.
- It conserves soil moisture by reducing evaporation of water from the soil surface.
- It increases water infiltration (down ward entry of water into the soil) by reducing surface runoff.
- Organic mulches decompose and add organic matter to the soil hence improving soil fertility and water holding capacity.
- Mulches moderate soil temperatures hence allowing soil microbes to stay in the soil and carry out decomposition so as to improve soil fertility
- Controls weeds by cutting off light supply to them at seedling stage.

- It improves on soil structure when the organic mulches decompose to provide organic matter.
- It increases yields in certain crops by providing manure and a weed free environment.
- Mulches can control certain pests like the banana weevils (***Cosmopolites sordidus***) which are trapped in the mulch.

Disadvantages:

- Mulches more especially the organic ones can be it when dry and destroy the crops in the garden.
- They can act as breeding grounds for pests like termites.
- Some mulches cause deficiency into the soil.
- Mulching materials are quite expensive for the farmers to purchase, transport, and lay in the garden.
- The vegetable material may be a source of weeds more especially when it is not completely dry.

III. **Crop rotation:** This is the system of growing different crops on the same piece of land in a sequence or definite order so as to preserve and maintain soil fertility.

IV. **Manuring**: Manures improve the soil structure thereby allowing water infiltration and binding of the soil particles together.

V. **A forestation**: Trees planted reduce soil erosion by wind and water since they increase water infiltration into the soil and bund soil particles together.

VI. **Wind breaks**: These are lines of trees planted perpendicular to the direction of the prevailing winds. They reduce the speed of the wind hence controlling erosion by wind.

VII. **Planting cover crops**: This are crops planted to reduce the rate of water runoff from the soil surface and holds the soil particles.

X-teristics of a good cover crop:

- It should be easy to establish and multiply
- It should grow rapidly and vigorously to suppress weeds
- It should not act as a competitor to the main crop.
- It should not demand too much Labour to control its growth.
- It should be tolerant to pruning and slashing
- It should strive well on a fertile soil
- It should be resistant to pests and diseases.
- It should have good forage which spreads over the soil
- It should be able to withstand sunlight during the early stages of growth.
- It should be able to tolerate shading by the main crop.
- It should be drought resistant so as to be able to survive long drought.
- It should not produce any substance that has toxic effect to the main crop.
- It should be easy to be removed when necessary and incorporated into the soil.

VIII. **Strip cropping**: Here crops and pastures are planted along the contours in alternate strips to reduce soil erosion by slowing down the speed of running water.

IX. **Intercropping:** When cereals are intercropped with legumes having broad leaves, soil erosion, can be reduced by the broad-leaved plant.

MECHANICAL/PHYSICAL METHODS OF EROSION CONTROL

Terracing: This is done in places with steep slopes where terrace is constructed to reduce the slope. The terraces can be of various forms like broad based terraces, narrow terraces and bench terraces. These reduce the speed of running water down the slope and encourage water infiltration.

Contour ploughing: This involves ploughing across the hill along the contours to reduce the extent of water run off over the surface of the soil by the help of furrows.

Bunds These are heaps of soil made across the slope to trap any water that flows down the hill to conserve soil

Ridges. These are the heaps of soil that are made across a slope on which crops are grown. They trap soil and water running down the slope

Gabions/barrages. These are obstructions/structures of stones mainly put in trenches to reduce the speed of water down the trench and trap any soil in the water flowing

Diversion channels. They are water channels constructed at the raised part of the field to divert water flowing down into the garden

Deep ploughing. Ploughing down to the subsoil increases water infiltration and hence reducing surface run off. This controls soil erosion

Graded banks. Water runoff in the garden is reduced by construction of banks and reducing of the slope. Water from each bank is conducted away

Absorption banks. These are channels constructed across the slope of the field to trap rain water for future use.

Grassed water ways. These drainage channels which lead away excess water and having grass planted in them to trap soil and reduce water speed

LAND RECLAIMATION

This is the practice of regaining or bringing back waste land to use so for cropping, rearing animals or settlement. Such land could be under swamps, rivers, forests, deserts of infested with pests like tsetse flies.

Methods of Reclaiming land:

These include the following: -

Deforestation, irrigation, terracing, draining swampy areas, afforestration, application of fertilizers, land clearing, pest control, leveling and stumping.

Deforestation: Here forests are cleared using bulldozers, motorized saws, axes or panga to release land for agriculture. However, this practice has other negative effects on the environment.

Draining swampy areas: Land drainage is a method of rehabilitating land by removing excess water from an area which is water logged.

Advantages of draining land:

- Drainages provide a good environment which encourages optimum root growth by improving aeration.
- Drainage raises soil temperatures since a wet soil is usually cold. This improves the growth of plants since they need warmth around the roots.
- Drainage allows tractors and other machines to move easily over the soil.
- It is important in controlling parasites like the liver flukes
- Drainage improves on the soil structure of a particular place.
- It creates a water table which does not fluctuate much good for citrus fruits.
- It improves root penetration into the soil hence proper growth of the plant.
- Crop losses during harvest which are due to wet conditions are minimized by draining land.

METHODS OF DRAINING LAND

The methods that can be used include:

Surface drainage: This is the removal of water from the surface of the soil by means of open ditches. Open ditches are used to remove excess (surface) water from low laying areas:-

Advantages of surface drainage

- It is easy to notice the blockages and therefore corrected easily.
- Open ditches are cheap to construct
- There are less chances of leaching in this method
- Does not dry out the soil completely hence preserving soil moisture

Disadvantages

- They are more prone to gully erosion which may be destructive.
- The ditches occupy good land which could have been used for crop growing.
- They interfere with mechanical tillage operation and livestock improvement.
- They are expensive to maintain
- Leveling should be done before water can flow into the drains which may be difficult to achieve

SUB-SURFACE (UNDER GROUND) DRAINAGE / TILE METHOD

This is where water is drained away from water logged areas through tiles or drain pipes laid under ground:-

Advantages of tile method (sub-surface drainage)

- It leaves the field free of surface obstruction
- It does not encourage gully erosion as observed in surface drainage.
- There is no need to level land to facilitate drainage.

Disadvantages of the tile method:

- May lead to excessive leaching in areas with heavy rainfall
- They dry out the land excessively at times and yet be in adequate during wet weather.
- They are expensive and require skilled Labour to install.

- They are easily blocked by roots of many perennial crops

Sub-soiling drainage.

This is the removal of surface water logging caused by the build up of an impervious layer using a heavy cultivation with one or more times that can penetrate up to 90cm deep. The operation cracks and loosens sub soil especially under fairly dry conditions.

Use of deep rooted plants

Plants like eucalyptuses which have deep rooted that can penetrate impervious sub soil can be used in draining land.

Terracing:

This conserves water and soil making the field easy to work with machinery. It is mainly done in hilly places.

Afforestration:

This is practice of planting trees in places where they died out or where they have never existed before. Trees are planted in areas such as hilltops or on slopes of mountains and hills, where no crops can grow.

Leveling:

This is done in places with anti-hills which hinder mechanization. The place is leveled to allow machinery use and crop production.

Land clearing:

This is carried out in order to meet the following objectives:

- To increase land for crop and animal production
- To make mechanization possible
- To discourage pests.

It can be done using hand method, mechanical method, chemical method, bush burning or use of explosives.

Fertilizers application:

This is done in order to reclaim poor soil more especially for crops production. Inorganic fertilizers can be added to improve the fertility of such an area.

Pest control:

Since pests are a problem since they are vectors of important diseases like sleeping sickness in humans and nagana in cattle for tsetse flies. Places with such pests should be sprayed to allow human settlement and agricultural production.

Stumping:

This is the removal of tree stumps from an area. It eases mechanization and provides more area for agricultural production.

Irrigation:

This is the practice of applying water artificially to the soil in areas where there is no rain or where rain is inadequate.

TYPES OF IRRIGATION

1. Surface irrigation

This is the application of water over the surface of land. It may include the following methods:

Flood irrigation	furrow irrigation
Border irrigation	basin irrigation

a. Flood irrigation:

In this method, water is applied by flooding flat areas. It is the most suitable areas in places with abundant and cheap water.

Advantages

Flooding can kill crop pests and diseases

It does not need the leveling of land.

Good for areas with abundant water supply

Disadvantages:

If the water flows fast, it may not infiltrate the soil.
Water logging and leaching of nutrients may occur
Surface runoff may cause soil erosion.
Little control of water supplied leads to wastage.
Excess water causes leaching

b. Furrow irrigation

Here water is supplied to rigid land from a main source through supply canals. The excess water collected from the bottom of the field in drains which lead to a water way.

N.B. Crops are normally grown on ridges which must be carefully panned.

Advantages

Water infiltrates uniformly

This method is suitable for row crops such as cereals since furrows can be made in a row form

Can use poor quality water since there are no pipes to be blocked

Disadvantages

There is a danger of salt accumulation in the furrow more especially if the water contains salts.

It may encourage soil erosion

Excess water may cause leaching

Movement in the garden by machines is impeded

May require grading of land which increases costs of production

Sometimes enough water does not reach the end of the furrows.

c. Border irrigation

In this method water from the supply canal is applied to the top end of strips of land which are divided by low earth bunds. Due to even grading of the land, the water flows in a regular uniform sheet down each strip wetting the soil as it advances.

d. Basin irrigation

This is a system used on leveled land to irrigate orchards mainly. A basin is made either for each tree or group of trees depending on the soil conditions and surface slope.

The advantages of this system are that the Labour cost is low and it uses less water.

2. Over head / sprinkler irrigation:

This involves supplying water just like natural rain. The system consists of a pumping unit which supplies water under pressure and it is sprinkled to the crops and soil.

Advantages

- Water delivery can be matched with crop requirements.
- Movement in the garden by machine is not affected.
- It does not require the leveling of land hence reduce the costs involved in that.
- It does not encourage soil erosion as observed in the surface methods of irrigation
- Agricultural chemicals such as fertilizers pesticides and herbicides can be applied uniformly with the irrigation water.
- Adapts to dry topography.
- The system does not require special skills to operate it as seen in drip irrigation.
- Can be integrated with several agronomic practices in the garden.
- It is an idea method in sandy soils and hilly areas
- Low maintenance costs.
- There is adequate infiltration of water into the soil which is important in crop nutrients absorption.
- Sometimes the high pressures of water from the irrigation system can kill pests.

Disadvantages:

1. The water droplets may have a hardening effect on the soil which hinders further water infiltration.
2. The system requires a high initial capital to install which may not afforded by the peasants.
3. Water does not tend to infiltrate very far into the soil more especially when pumped in small amounts.
4. There is a risk of salt accumulation around the root zone areas.
5. If the weather is windy, the application of water becomes uneven.
6. The system has been known as one way in which pathogens are spread in gardens (pathogens are diseases causing organisms)

3. Drip / Trickle Irrigation

This is relatively new method of irrigating crops and is mainly used in the USA, Australia and Israel. Water is supplied through plastic pipes to each row of crop plants and a small nozzle allows water to trickle out and provides moisture around the plant roots.

Advantages

- Water is delivered near the root area so that the crops the crops can get a good supply of water.
- There is less chances of water evaporation and accumulation of salts as in overhead and surface irrigation.
- The area between the rows in not invaded by weeds since there is no water supplied there.
- It is a very economical way of using water since it involves less wastage.
- Fertilizers can be mixed in the water and supplied to the crops.
- Low pressure is required to pump the water through the system hence saving energy intake.

Disadvantages

- It requires a high initial capital to purchase and install the requirement in ths type of irrigation.
- The system requires good quality water which can not block the pipes.
- It is unsuitable for steep and uneven areas

FACTORS THAT DETERMINE THE TYPE OF IRRIGATION TO BE USED IN AN AREA:

1. The source of power

Abundant power supply in an area can encourage some body to use overhead irrigation since there is power to pump the water.

2. Type of soil

Loose sandy soils are not good for the surface methods of irrigation since they are more prone to erosion. But over head irrigation can be good in such places.

3. Topography

An area with hills and valleys can only allow overhead irrigation which doesn't involve the leveling of land.

4. Type of crops grown.

The growing of high value crops can allow the use of costly irrigation methods like drip and sprinkler irrigation methods since a farmer will be able to cover the costs.

5. Methods of planting crops

Crops planted in row can allow the use of drip irrigation method and most of the surface methods which can't be used in broadcasted crops.

6. Availability of water.

Places with limited water supply can efficiently apply drip irrigation method since it is more economical in the use of water.

7. Capital

The availability of enough capital will allow a farmer select any type of irrigation methods since he can afford all the costs involved.

8. Knowledge and skills

Some methods of irrigation like drip require special skills and knowledge which must be readily available during installation and maintaining

9. Climatical records:

These will show the natural water available to the crop in order to determine artificial application needed in a particular period.

CROP PRODUCTION

FACTORS THAT DETERMINE / AFFECT CROPS GROWN IN AN AREA.

The factors are divided into two broad group's i.e.

- Abiotic factors
- Biotic factors.

ABIOTIC FACTORS

These are factors that are a result of non living part of the environment e.g

Soil fertility	*Soil density*
Soil texture	*Quality and quantity of light*
Humidity	*temperature*
Rainfall	*wind*

Day length

1. Soil PH

Different crops require different specific pH for their proper growth e.g. tea require acidic soil, tobacco may require slightly acidic soil.

2. Soil fertility

Crops are nutrients which must be readily available for their proper growth.

3. Soil drainage.

Some crops like rice are able to thrive in poorly drain soil while others like maize cannot withstand poor drainage.

4. Soil structure

This affects the movement of air, transfer of heat and root development.

5. Soil texture

This can also affect the number of physical properties of soil which are very crucial to crop growth.

6. Temperature

Some plants like the cereals and grases can live in area with high temperature. Since they are the mechanism of closing their stomata durig the day.

7. Availability of water.

Water is used as a raw material for photosynthesis. Absence of water in a particular area can limit the growth of a particular crops more especially these that are not drought resistant in bananas.

8. Topography

This determines the number of factors like temp, humidity rainfall which all affects crop growth.

9. **Pest and diseases**.

Crops in some areas have been eliminated due to the presence pest and diseases. e.g. Tomato growing in most areas of Uganda is limited by bacterial wilt.

10. **Wind**.

At high attitudes strong winds are experienced which will affect the growth of crops.

11. Social factors

Some communities are growing certain crops since historically they have acted as food crop e.g. millet among the Itesot of Uganda.

12. Economic reasons

Some crops are cash crops therefore they must be grown to provide farms with income e.g coffee, tea, cocoa.

13. Government policy.

The government has been restricting the growth of certain crops for health reasons and security e.g. Opium / Marijuana.

CLASSIFICATION OF CROPS;

Crops are classified into two main groups

a) Annual crops
b) Perennial crops

ANNUAL CROPS

These are crops which complete their life cycle within one year e.g.

i. Cereal (millet, Sorghum, Rice, Wheat, Barley, Maize, Oats, and Rye)
ii. Legumes (Beans, Soybeans, Cowpeas, Pigeon peg, G-nuts)
iii. Root Crops (Cassava, Sweet potatoes, Irish potatoes, Yams,)

iv. Vegetables (cabbages, tomatoes, onions, egg plants, amaranthus spp, carrots, dodo, spinach, pumpkins, cucumber, water, melon, garlic, pepper.)
v. Oil crops (Simsim, sunflower, cotton)
vi. Fiber crops ((cotton)
vii. Drug crops (Pyrethrum)

PERRENIAL CROPS

i. Beverages; coffee, tea, and cocoa
ii. Fruits; pawpaw, guava, avocado, jack fruit, passion fruit, pineapples, bananas,e.t.c
iii. Citrus; oranges, lemons, tangerines, e.t.c.
iv. Sugar crops; sugar cane and sugar beet
v. Spices; vanilla, ginger, clover, e.t.c.

CEREALS

These are commonly known as grain crops and they have a high content of carbohydrates. They are the most common food crops used all over the world.

REASONS WHY CEREALS ARE THE MOST FOOD USED IN THE WORLD.

1. They are easy to prepare as food for example rice and posho.
2. They are adapted to a very wide range of soil and the environmental condition.
3. They have fewer pest and disease as compared to other crops.
4. Cereals contain a high amount of carbohydrates and vitamin which are highly needed in our diet.
5. Because they contain low moisture content they are easy to store and used when needed.
6. Cereals have a short life cycle as compared to the crops and other perennials.
7. Cereals can be used as food for both man and animals.
8. Because they are less bulky hence it is easier to transport cereals from one place to another.
9. Management practices like plant, weeding, can be easily done by machines reducing Labour requirements during production.
10. They do not require special seed bed before being planted.

MAIZE - ZEA MAYS

Plant characteristics

1. Maize is an annual cereal crop which can grow up to a height of 4- 6 metres
2. A mature and a growing maize has a prop root radiating from the main stem outward into the soil providing support. The depth of the root depends on number of factors e.g. soil, rainfall etc.
3. The tassel i.e. male maize inflorescence emerges at the top of the plant and shed its pollen over a period of about one week.

4. The silk i.e. female inflorescence emerges from the ear outwards towards the end of pollen shedding and remains conceptive for a period of about three weeks.
5. In good condition maize leaves are green with parallel vein and long i.e more than 0.5m.
6. At an early stage of growth it can be plough down as green manure to provide nutrient into the soil.
7. Young maize can be used for making hay for feeding livestock however it can bring digestive problem if the maize is a mature one due to fibrous content.
8. Maize flour contain a lot of carbohydrates when eaten it can be metabolized to provide energy to support the organism.

Growth requirements

9. Maize requires a well drained soil with a good supply at nutrient
10. It can not tolerate a slightest degree at water logging.
11. It requires enough rainfall which is equally well distributed but however, during harvesting it should be as compared to during silking where enough water is needed.
12. Maize thrives very well between temperatures of 20 – 25^0 C. High temperature during the day is accompanied by high rate of transpiration and low temperature at night is accompanied by a high rate of respiration thus limiting yield.

Seed bed preparation

13. Seed bed preparation is done by hand roughly this in turn advantageous because weeds are killed, encourage water infiltration and resist soil erosion than in fine seed bed.
14. Secondary cultivation may not be necessary since the crop has big seeds.

Planting and spacing

15. It should be planted at the beginning of the rain because early planted maize benefit from nitrogen flush that occur when a dry soil are wetted and suffers less from fungal diseases
16. Planting is done mechanically by planter or by hand. Two seeds are planted in one hole made at 5cm deep in moist soil but in dry soil should be placed 10cm deep to prevent it germinating as a result of only a slight shower.
17. Spacing should ensure low population Atleast 90 cm X 30 cm between each plant. This is to reduce competition for basic growth requirement. However spacing can be determined by other factors like soil fertility, soil moisture, variety, e.t.c.
18. In properly spaced maize in area of reliable rainfall weed free condition need only to be maintained until the crop is 45cm high. After this height the crop suppresses weeds by itself.

Weeding and fertilizer application

19. Maize is weeded when its between 10 - 15cm and before it starts silking
20. selective herbicides can be used to control weeds like atrazine herbicide
21. Nitrogen fertilizers should be applied as top dressing when maize is at about 45 cm high.
22. Phosphates should be incorporated into the soil at the time of sowing.
23. Farm yard manure can be applied to the soil to increase its fertility owing to maize growth and development.

Pest and disease control

24. Pests that affect maize include stalk borer and army warm which its larvae may eat all the leaves until only remain midrib.
25. Few diseases like white leaf blight, maize streak caused by virus and rust caused by fungus attack the crop.
26.

Harvesting and yields

27. Harvesting maize is done mechanically by combine harvester and manually by hand.
28. Maize grain is physiologically mature at a moisture content of about 35%. when left in the field to dry it is reduced to 19 – 20% after the husks has been removed.
29. Maize is dried and stored in the crib i.e. a store with wall of wire netting.

Question.

Describe the agronomic practices carried out in the growing of rice from planting to harvesting.

- Plant characteristics.
- Ecological requirement of the crop (soil, rainfall, humidity, temp)
- Importance
- Seed bed preparation
- Planting
- Weeding (thinning, pruning)
- Fertilizers application
- Harvesting
- Yield
- Storage.

VEGETABLES

1. They are sources of income when a farmer decides to sell.
2. They are very good source of vitamin like vitamin A and C.
3. They act as appetizers for food e.g. onions and tomatoes.
4. They are a good source of minerals e.g. Iron, magnesium.
5. They heap in controlling digestive problem like constipation
6. They can be used as animal feeds like cabbages to rabbits.

7. Vegetables growing provide employment for people working as attendants in vegetable gardens.
8. Vegetables are a good source of manure since they rot fast.
9. Leguminous vegetables fix nitrogen into the soil e.g. beans
10. They can act as cover crops hence controlling soil erosion.
11. Some vegetables have medical value e.g. Malakwang, Red Amaranthus.

CLASSIFICATION OF VEGETABLES

Vegetables can be classified into two ways. i.e. according to the part eaten and family

ACCORDING TO PART EATEN.

1. **Leaf vegetables**
   - Cabbages
   - Amaranthus
   - Spinach.
2. **Fruit vegetable**
   - Egg plant
   - Tomatoes
   - Water melon
   - Cucumber
   - Pumpkin.
   - Okra
3. **Seed vegetables**
   - Cowpeas
   - G-nuts
   - Beans
   - Garden pea
   - Field pea
4. **Root vegetables**
   - Onions
   - Sugar beet
   - Garlic
   - Carrots
   - Irish potato
   - Turnip
   - Radish
5. **Flower vegetables**
   - Cauliflower

Family classification

Here vegetables are grouped into six families: -

1. **Leguminosae (pulse)**
   This include

- Beans
- Pigeon pea
- G-nuts
- Garden peas
- Cowpeas

2. **Solanaceae (Tomato family)**

This include

- Irish potatoes
- Egg plant
- Tomatoes
- Sweet pepper

3. **Brassicaceae (cabbage family)**

It includes

- Cabbage
- Cauliflower
- Radish
- Turnip
- Kale

4 **Cucurbitae (gourd family)**

Includes

- Pumpkins
- Water melon
- Cucumber
- Gourds.

5. **Alliaceae**

This includes

- Onions
- Leek
- Garlic

6. **Apiaceae**

- Carrots
- Parsely
- Celety
- Carriander
- Parsely.

7. **Amaranthanceae**

- Amaranthus hybridus
- A. dubius
- A. caudatus

PROCEDURE FOLLOWED IN GROWING VEGETABLES

1. Choosing the site.

The site to be considered for growing vegetable should measure up to the following: -

a. The soil should be deep and fertile. Incase at low fertility fertilizers should be applied.
b. Availability of water, the site should have enough water supply hence the site should be close to a water source.
c. Distance from home. The site shouldn't be far from home for security reasons and easy management.
d. The area should be free from frost and the farmer to effect this should avoid valley bottom.
e. The place shouldn't be having shade since some vegetable like tomato and egg plant do not thrive well in shade.
f. Gentle slope or flat land and require for fair drainage.

2. Preparing a nursery bed.

A nursery bed is an area where seedlings are grown before they are transferred to the actual vegetable field / garden. The seeds can be planted in a seed bed, seed boxes or soil blocks.

Treatment of planting materials

- Seed dressing –coating seeds with pesticides e.g. copper Sulphate.
- Chitting or encouraging sprouting e.g. in potato seeds.
- Inoculation, usually done legumes where seeds are coated with right bacterial for nodule formation.
- Hot water treatment against viral diseases e.g in sugarcane and cassava.

Importance of a nursery bed.

- When propagating seeds which are too small to be planted directly into the soil.
- The crop seedlings are delicate and need great care
- Bulking up of planting materials is necessary like in sugarcane
- Helps in selecting healthy and strong seedlings.
- When cuttings to propagate the crop need special treatment e.g. tea.

Procedure of making a nursery bed

- Remove all grasses, roots and tree stumps from the area.
- The place should be cultivated deeply to encourage proper root development.
- All large soil pieces should be broken down to encourage a fine bed.
- Incorporate manure containing phosphorous into the soil to improve fertility
- Leave the area to settle for Atleast 3 – 4 weeks before planting seeds
- Measure off the nursery bed to a width of 1 metre and any length that you feel.
- Erect a shade on the prepared place to control light and water delivered to the seedlings.
- Make ridges across the bed where the seeds are to be planted.

- Place the seeds in the ridges and cover it with a thin layer of mulch to facilitate germination.
- Place a thin layer of mulch over the seeds to conserve soil moisture and control weeds.
- As soon as the seeds germinate the mulch should be removed since it may interfere with germination.
- The seeds should be watered twice each day in the morning and evening.
- After germination excess seedlings can be removed a practice called pricking-out.
- At a later stage before transplanting seedlings are exposed to environmental conditions referred to as hardening off
- Transplanting should be done in the evening hour or morning to reduce the rate of water loss from the seedlings by transpiration.

3. Preparation of a seed bed.

A seed bed is a well-prepared piece of land ready to receive planting materials. E.g. Suckers, seeds, bulbs, cuttings etc.

- The land should be cleared of large bush, all trees and grasses
- All tree roots and stump should be removed in advance.
- The whole place should be deeply cultivated and big pieces of soil broken.
- The whole place should be measured to establish the size in accordance to the number of seedlings to be planted.
- The place should be leveled before planting seedlings.
- The whole vegetable should be along the contour of land to reduce erosion.

Nursery bed management

- Seedlings must be watered Atleast twice a day i.e. in the morning and evening**.**
- Apply fertilizers to the seedlings to improve growth.
- Apply pesticides to control pests on the seedlings
- Spray fungicides on the seedlings to control fungal infections like dumping-off.
- Provide a good shade over the nursery bed to control damage to seedling due to harsh environmental conditions.
- Remove diseased and excess seedlings from the nursery bed i.e. prick out to reduce disease spread and allow proper seedling growth.
- Weed the bed to reduce competition for nutrients and control disease spread.

4. Transplanting

Precautions to be taken when transplanting

- Seedlings in the nursery bed should be well watered before lifting to reduce root breaking
- Seedlings should be lifted with soil in their roots to control distorting of roots.

- Care should be taken not to damage roots as it may deter proper crop establishment and development.
- Transplanting holes should be big enough to accommodate seedlings without bending roots since it may affect root development.
- Where fertilizers are used it should be thoroughly mixed with soil for efficient utilization by the seedlings.
- Seedlings should not be planted deeper than they were in the nursery for proper establishment.
- Transplanting should be done during the cool hours to reduce wilting of seedlings through excessive loss of water by transpiration.
- Seedlings should be watered after transplanting if the soil in the field is dry to provide adequate moisture for crop establishment and growth.

Transplanting the seedlings.

1. Only healthy, strong seedlings should be selected.
2. Watering of the nursery to soften the soil to ease transplanting and reduce root damage.
3. Transplanting should be done in the evening or in cool weather.
4. Thorough preparation of the seedbed by removing all tree stamps and roots remove any other vegetation Atleast two months before transplanting.
5. Dig holes before transplanting at the required spacing
6. Fill the holes with a mixed top soil and double supper phosphate or organic manure Atleast 2 -3 weeks before planting.
7. Top soil and sub soil should not be mixed but filled to holes separately
8. Transplant at the beginning of rain for easy crop establishment.
9. Provide temporary shade to the transplanted plant (seedlings)
10. Mulch around the seedling
11. Continue watering until the plant has fully established it's self.

5. Application of fertilizers.

- Vegetable require more of N, P and K which should be applied early for vigorous plant growth.

6. Weeding

Effective weed control is needed to ensure proper growth of the vegetable since they are more sensitive to competition.

7. Disease and pest control.

Vegetables are attacked by a number of fungal and bacterial diseases like dumping off, downy mildew, bacterial wilt, mosaic, dry rot, black rot, stem rot, and blight. The common pests are cut worms, termites, grasshoppers, caterpillars, mole crickets, aphids, thrips, nematodes and beetles.

8. Harvesting

Most vegetables are early maturing and are normally harvested manually after harvesting they should be kept in a cool place to that they don't go bad.

GROWING OF TOMATO SEEDLINGS FROM NURSERY BED PREPARTION TO TRANSPLANTING.

1. Select a good site for vegetable production
2. Remove all vegetation from the area where to prepare the seed nursery bed.
3. Cultivate deeply removing all roots from the bed.
4. Raise a nursery bed to facilitate good drainage.
5. Incorporate well rotten F.Y.M / compost or S.S.P fertilizer.
6. Level the soil by raking and remove any foreign material like stone, polyethene or glasses and break any big clods of soil.
7. Sow the seed at 0.5cm deep and cover lightly with soil
8. Spacing should be 15cm between the rows.
9. Mulch the bed lightly and remove after seeds have germinated
10. Erect a shade over a nursery bed to protect seedlings from harsh environmental conditions.
11. Water from the top of the shade twice a day, morning and evening using a watering can.
12. When the seedlings grow up to about 2.5cm high, prick out to ensure proper spacing and growth.
13. Weeding should be carried out with a garden trowel or suitable tool
14. Spraying seedlings with copper fungicides such as ridomil and diethane M45 to control late blight and other pests should be done.
15. As seedlings near 15cm in height, reduce the shade to ensure hardening off.
16. A week before transplanting water the seedling to ensure the soil is soft to avoid breaking roots.
17. A week before transplanting, remove all the shade to ensure full hardening off.
18. Transplanting should be done in the evening or cloud cast day to reduce water loss from the seedlings.
19. At transplanting use a trowel to remove seedling with soil around the roots.
20. At transplanting use a trowel to remove seedling with soil around the roots.
21. Water immediately after transplanting.

Diseases of tomato.

Tomato Blight-It's a fungal disease, it attacks leaves, stems and fruits causing brown – black sunken lesions.

- It's very severe in humid weather.
- It can be controlled by spraying with copper fungicides such as Ridomil and Diethane M45.

Bacterial Wilt - Its caused by pseudomonas solanacearum, it causes wilting and death of growing point and upper leaves.

- Its airborne and controlling its spread is difficult. However, the following control measures are recommended: -

- Remove and burn all infected plants.
- Crop rotation
- Use resistant varieties
- Sterilize the soil by burning grass on top or apply formalin or boil
- By fallowing

Tomato Mosaic -This is a rival disease, which causes curling and molting of leaves thus reducing the area of photosynthesis.

- It may be transmitted from tobacco shred or a smoker's hand

Its controlled by

- planting resistant healthy seeds
- burning all affected plants and planting healthy seeds
- smokers should wash their hands before touching tomato plants.

Pruning tomato

- One or two stems are left per plant.
- Remove lateral shoot weekly
- When 6 – 8 trusses of flowers pinch out the growing it this pruning will encourage the growth of good size marketable tomato.
- Remove leaves close to the ground to prevent the entry of blight.

Importance of pruning tomatoes

1. Improves the quality of fruits by exposing each to enough light.
2. Improve yields by ensuring big fruits due a reduced competition for nutrients between various branches
3. Makes spraying against disease more easy
4. Removes a micro climate that can encourage pests.
5. Harvesting becomes easier since fruits are properly exposed
6. Makes movement within the garden simpler.

Staking tomatoes

There are several methods of staking tomato the common method includes: -

- Single staking
- Cross staking using a wire cross poles.

Importance of staking tomatoes

1. Controls fungal diseases that can attack tomato fruits especially soil borne diseases.
2. Improves the quality of fruits by preventing contact between soil and fruits.
3. Prevents pest attack of tomatoes by crawling pests

4. Exposes fruits to adequate air and light which improves quality.
5. Reduces wastage of pesticides by exposing fruits for easy spraying.
6. Make movement with in the garden easy.

LEGUMES

These are plants with root nodules which are able to fix nitrogen into the soil.

IMPORTANCE OF LEGUMES.

1. They are good sources of protein for human and other animals e.g. soybeans, with a protein content of 38 – 40%
2. In pasture they provide protein for grazing animals
3. Symbolic bacteria in the root nodules of legumes fix atmospheric nitrogen into the soil.
4. Fast growing leafy legumes are good for making green manure.
5. Legumes grow and cover the ground very quickly hence can be used as cover crops.
6. They are deep rooted hence help in recycling nutrient and opening up the soil thus increasing ration and infiltration.
7. In any dry area legume shrub provide fodder for animals.
8. Legumes regenerate faster and produce more nutritious vegetative parts hence can be continually grazed by animals.
9. Some legumes are used in the manufacture of medicine and dyes
10. Industrial products made from legumes such as ground nuts cake are fed to livestock.

CHARACTERISTICS OF LEGUMES

- They have trifoliate net vein leaves.
- Most legumes have root nodules which contain nitrogen fixing bacteria\
- They bear pods which contain seeds.
- They have a tap root system.

ROOT CROPS

They are crops which have swollen roots or under (ground stems) in which large quantities of starch are stored.

IMPORTANCE OF GROWING ROOT CROPS.

1. They grow in a variety of soil and can be good source of food for most of the areas.
2. They require little labour and attention hence cheap to produce
3. The tuber can lie in the ground until required and therefore available throughout the year.
4. Most root crops are resistant to drought hence can be produced in area of little rainfall.
5. Root crops are attacked by few pest and diseases as compared to other crops.
6. They are able to give high yield even in poor soil hence solving the problem of hunger.
7. Compared to cereals and legumes, root crops require little processing before they are eaten.

LIMITATION OF ROOT CROPS GROWING.

- They are bulky and therefore difficult and expensive to transport
- They have a high moisture content hence difficult to store.
- They are low in protein, fat, vitamin, and minerals hence needs supplementation.
- They are propagated vegetatively therefore the planting material is difficult to transport.

PERENNIAL CROPS

These are crops which complete their life cycle in more than one year coffee, tea, cocoa, sisal, cashew nut, sugar cane, citrus fruits, pawpaw, banana, pineapple.

IMPORTANCE OF GROWING PERENNIAL CROPS IN AN AGRICULTURE SYSTEM.

1. The cost of establishing is spread over a number of gear hence can lower than that of annual.
2. Harvesting is continuous after establishment which reduces Labour.
3. They may be used as security in acquiring loans from the bank.
4. They increase value of land whenever planted.
5. The cost of controlling pest and disease is generally lower than that of annual.

LIMITATION OF PERENNIAL CROP PRODUCTION

1. Require a lot of land to be grown because of their wide spacing.
2. Perennial take long time to mature therefore waste long which could have been used for short term profitable crop.
3. Some of the perennial require irrigation so a permanent water source may be necessary.
4. Some perennial do not have seeds and therefore must be vegetatively propagated which is a bit expensive.
5. The processing of these crops may have to be done on the farm reducing the land area that could be used for crops.
6. The average yield for most perennials is low.
7. Perennials are very difficult to improve because breeding programmes are at along term nature and very expensive.

The perennials are also grouped into families e.g.

1. Rubiaceae - Coffee
2. Theacede - Tea
3. Sterculiaceae - Cocoa
4. Anacardiaceae - Cashew nut -- Mango
5. Agavaceae - Sisal
6. Graminae - Sugar cane

7.	Rutaceae	-	Citrus fruits
8.	Caricaceae	-	Papaw (*Carica papaya*)
9.	Musaceae	-	Banana
10.	Bromeliaceae.	-	Ananas cosmosus (pineapple)

GROWING COFFEE FROM NURSERY BED TO HARVESTING

1. Choose a suitable site with a good deep, well drained fertile soil from any shade.
2. Plough the area a depth of 0.6m to a tilth i.e. deep ploughing
3. Remove all plants roots, stones, weeds and break all big clods then level the soil using a rake.
4. Incorporate manure i.e. compost manure or SSP.
5. Sow/ plant seeds at a depth of 2.5m in a nursery bed at a spacing of 15cm by 15cm or 20cm x 20xm.
6. Mulch and water thoroughly using watering can mulches are removed immediately after germination.
7. Erect a shade to last atleast for one month.
8. water regularly nursery life last for 1 ½ year
9. weeding, thinning, pricking out should be done to avoid competition
10. control pest and disease
11. Hardening of the seedling before transplanting this is done by reducing water interval, reducing the shade.
12. Only healthy, strong seedlings should be selected.
13. Watering of the nursery to soften the soil to ease transplanting and reduce root damage.
14. Transplanting should be done in the evening or in cool weather to reduce water from the seedlings.
15. Thorough preparation of the seedbed by removing all tree stamps and roots or any other vegetation atleast two months before transplanting.
16. Dig a hole two months before transplanting at a spacing of 2.7m x 2.7m and 60cm deep and 60cm wide.
17. Fill the holes with a mixture of top soil and double supper phosphate or organic manure atleast 2 -3 weeks before planting.
18. Top soil and sub soil should not be mixed but filled to holes separately
19. Transplant at the beginning of rain after 1 ½ year when the plant is ready to leave the garden.
20. Provide temporary shade to the transplanted plant (seedlings)
21. Mulch around the seedling
22. Continue watering until the plant has fully emerged.

Examples of coffee diseases.

1. Coffee berry disease.

Its caused by a fungus, which causes brown sunken spot on the berries making them difficult to pulp.

2. Antestia bugs

This suck berries and cause zebra strip hey also feed on terminal bud and causes pan braking.

Control is by spraying with parathion and open pruning.

Other pests include:-

- Mealy bugs
- Coffee thrips
- Lace bugs
- Scale insect.

The above pest can be controlled by spraying with dieldrin and fenthion.

Advantages of pruning coffee.

1. It increases quality of berries by controlling over bearing.
2. Make harvesting easier.
3. destroys micro-climate for certain pest and disease by reducing over crowding
4. making weeding and spraying easier
5. It increases the yields.
6. keeps plants health and more vigorous

SEED BED

This is a piece of land and has been prepared to receive planting materials like wilting seeds, leaves, stems, leaves, bulb combs.

Seed bed preparation includes activities like ploughing, harrowing, digging, slashing, burning etc.

Tillage is the disturbance of land with an aim of killing weeds and providing a conducive atmosphere for successful plant establishment and growth.

TYPES OF TILLAGE

There are two main types of tillage i.e.
Primary
Secondary

PRIMARY TILLAGE

Is the initial preparation of land which can involve cutting trees clearing bushes and initial ploughing.

AIMS

1. To kill weeds by either burying or desiccation thorough exposure to sun
2. To burry crop residues of the previous season so as to provide manure and give space for the new crops.
3. To loosen the soil so as to allow water infiltration
4. To improve air circulation in the soil for proper root development
5. To disturb pest by exposing them to sun which easily kills them

6. Primary tillage can be used in controlling soil erosion by leaving the field rough.
7. Can provide good conditions for planting seeds through deep tillage and removal of obstacles.
8. To dig surface vegetation so that it can decompose more easily and enrich the soil.

SECONDARY TILLAGE

This is the subsequent seedbed preparation after primary tillage.

AIMS

- To cut vegetable materials and crop residue and mix it into the soil.
- To control weeds that may have come up after primary tillage
- To improve soil aeration by further breaking the soil clods
- To mix fertilizers /manure with soil.
- To cover the broadcasted seeds with soil.
- To level and firm top soil surface to as ease planting using any given method.
- To control pest by exposing them to ash environmental conditions.

WAYS IN WHICH TILLAGE CONTROLS PEST.

1. Exposes adult pest, eggs or larva to predators that eat them up and reduce pest population.
2. Expose adult pest egg or larva to harsh conditions that can cause their death.
3. It buries pest and kills them by suffocation thus reducing their population.
4. Destroys weeds which act as alternate host for pest.
5. Remove crop residues thus breaking life cycle of pest.
6. Destroys breeding place of pest causing them to run away,

FACTORS THAT DETERMINES A NUMBER OF TILLAGE OPERATION

1. The type of seed or planting, materials to be used e.g. small seeds require a fine seed bed which can only be produced after secondary tillage.
2. The initial condition of land – land which has few obstructions may only require one tillage operation.
3. The type of soil – sandy soils are very loose and therefore frequent cultivation destroys their structure making it more prone to erosion.
4. The cost of any tillage operation – the higher the cost the less the number of tillage operation.
5. Type of vegetation – A place with a number of trees and shrub will always require secondary tillage since it's difficult to get a good seed bed at the tillage.

6. The tools or equipment used – use of heavy tillage equipment can produce a fine seed bed even after the first tillage.
7. Season of the year – During dry season weeds are few and even have less power of regrowth hence one operation can be enough.

PLANT PROPAGATION

Propagation is a way in which plant population is increased by allowing plants to reproduce them selves.

Plants are propagated into two main ways i.e.

- Seed propagation
- Vegetable propagation

Treatment of planting materials

- Seed dressing –coating seeds with pesticides e.g. copper Sulphate.
- Chitting or encouraging sprouting e.g. in potato seeds.
- Inoculation, usually done legumes where seeds are coated with right bacterial for nodule formation.
- Hot water treatment against viral diseases e.g. in sugarcane and cassava.

SELECTION OF PLANTING MATERIAL

In order for a farmer to reduce the expenses the need to select the planting material that he is sure of.

CHARACTERISTICS OF A GOOD PLANTING MATERIAL

1. Should be readily available within locality to reduce transport expenses and time wasted in looking for it.
2. It should be pest and disease free to reduce the transmission of such diseases and pest to the seedling.
3. it should be easy to transport i.e. should not be bulky.
4. Incase of seeds should be of uniform size and shape to allow easy mechanization during planting.
5. It should be easy to store so that it can use in future when needed.
6 Incase of seed they should have passed the dormancy stage.
7. The planting material should be highly viable to reduce the costs involved in filling up the gaps where they did not germinate.
8. Seeds should be of uniform colour to allow easy sorting and planting.
9. The planting material should be of high proven performance give high returns once planted.
10. Materials should be free from contamination by weeds.
11. Should be free from mechanical damage.

12. Incase of seeds, should be large enough.

SEED PROPAGATION

This is where seeds of mature plant having desirable qualities are used for planting.

ADVANTAGES

1. Seeds are not bulky and therefore are easy to handle and convenient to transport.
2. They can be stored for along time while retaining viability
3. Seeds are easy to treat against pest and seed born diseases
4. Seeds are easy to use during machine planting.
5. Seed planting is a quick method of increasing a crop population in a short period.
6. Some crops are difficult to plant vegetatively.
7. Plants raised from seeds have a longer life span than those raised vegetatively.

DISADVANTAGES

1. Some seeds are delicate hence difficult to handle during planting.
2. Seeds require special field preparation before planting more especially those with small seeds.
3. The method may introduce undesirable in the plant population.
4. Some seed may not breed true to type hence disappoint farmers
5. The formation of seeds requires special condition during pollination and fertilization.
6. Due to interference during pollination seeds may be formed but of a high degree of variability.
7. Crops raised from seeds take a longer time to mature.

VEGETATIVE PROPAGATION

This is the reproduction of plants from plants part that are not associated with reproductive organs.

ADVANTAGES

1. The offspring is similar to the parent in all ways hence preserve good mother characters.
2. Offsprings grows faster and mature early.
3. Offsprings are strong and hardly compare with seedling obtain from seeds.
4. Vegetative propagation is the best way for propagating plants with no viable seeds.
5. Daughter plants obtain food from their parents until they are sufficiently strong hence increasing chances of survival.
6. multiplication of the plant population is faster

7. over comes the problem of prolonged dormancy in some seeds

DISADVANATGES

1. It may cause over crowding due to the ability to establish quickly and grow fast.
2. It may cause over crowding due to the ability to establish quickly and grow fast.
3. The planting materials are quite bulky and therefore difficult to handle store and transport.
4. Due to their high moisture content vegetative materials are difficult to store.
5. Some vegetative methods of propagation are complex and hence need a lot of skill to execute.
6. A small hectare can be covered during planting as compared to seed propagation.

METHODS OF VEGETATIVE PROPAGATION

1. Layering - Mainly used in passion fruits.
2. Grafting - Used in most fruits like citrus, avocado, mangoes etc.
3. Budding - Can be used in fruits also like citrus.
4. Tissue culture- group of cells are developed into a new plant or plants

5 Use of storage structures
a. Bulbs - Used in onions and garlic.
b. Bulbils - Used in sisal
c. Suckers - Used in banana and pineapple
d. Rhizomes. - Used in ginger
e. Runners - Used in strawberry
f. Corms - Used in cocoyam
g. Splits - Used in pyrethrums
h. Stem tubers- Used in Irish potatoes.
i Cutting - Used in cassava sweet potato, clonal coffee.

GRAFTING

This is where two different stems are united in woody plants. The upper part of the union is called a scion while the lower part is called a stock.

PRINCIPLES OF GRAFTING

For successful grafting, there are about five principles which must be adhered to;

1. Compatibility – The scion and stock must be related or close to facilitate sexual hybridization.
2. Cambial alignment – The cambium of the scion and root stock should be aligned for the union form.

3. Timing of the grafting operation – Grafting must be done at a time when the root stock is in a proper physiological state.
4. Avoiding desiccation – After grafting operation make sure that all the surface is sealed off using wax or grafting tape around the joining
5. Pressure – Apply a pressure after aligning the cambium of the root stock and scion such that the xylem stays in contact.

REASONS FOR GRAFTING PLANTS

1. It changes the tree top from being undesirable to desirable
2. It makes it possible to grow more than one fruit or flower in the same plant.
3. Root stocks with desirable character like disease resistance, problem of water logging are used which may be beneficial to the scion and farmer.
4. It helps to propagate clones that cannot be propagated by any means.
5. It helps propagating special plants form e.g. seedless oranges.
6. Helps in change variety for more especially when the acid
7. Virus indexing – Plants having viral infection with no signs will show signs when grafted.

LIMITATION OF GRAFTING

1. Incompatibility – this failure of grafted material to survive due to a difference in genetic constitution.
2. Requires a lot of skills and experience for successful grafting to occur.
3. Requires a lot of time for tangible results to be got.

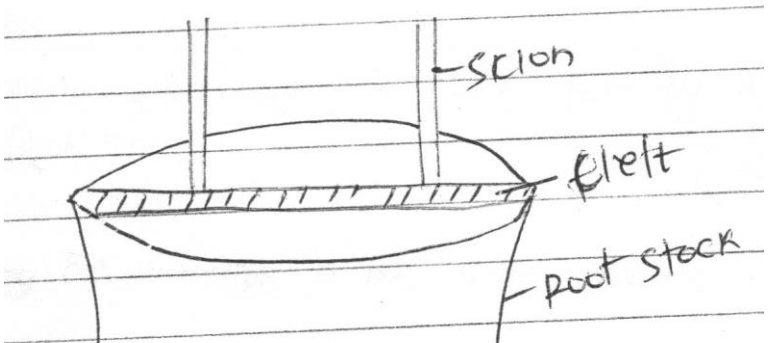
METHODS OF GRAFTING

1. Top Wedge

A cut surface of the scion forms a wedge that is inserted into a vertical slit on the root stock that has been slash.

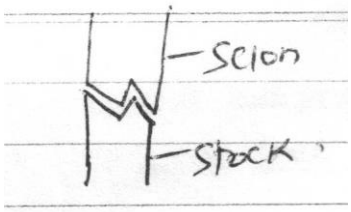
2. Cleft Grafting / Top working.

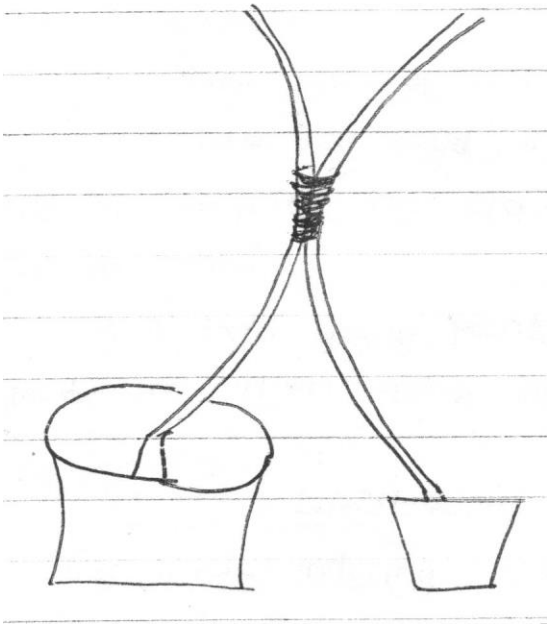
This involves grafting a scion into a canopy of a relatively large established tree.



3. Whip and tongue grafting

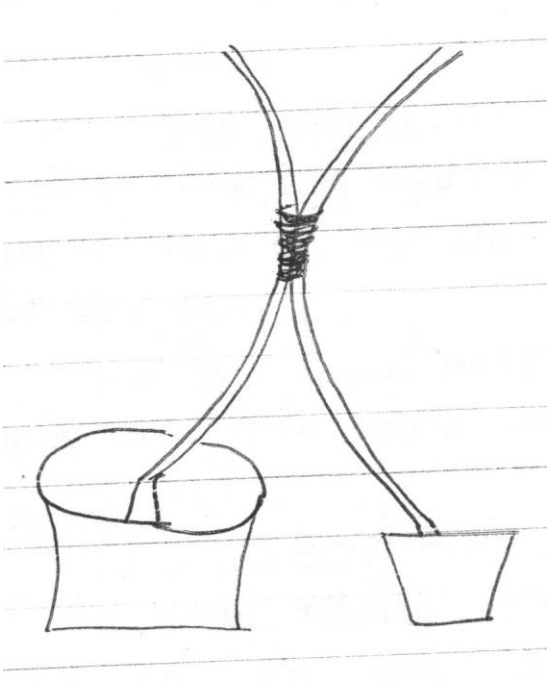
This is done if the root stock and scion have the same dimensions. A stanty cut is made at the base of the scion top of the root stock. The two are fitted together and waxed





4. Approach grafting

Here both the scion and stock remain attached to another plant until a secure union has been formed.

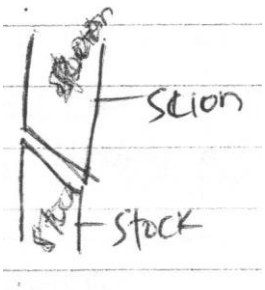


5. Bridge grafting

This is used in repairing damage free plant normally woody trunks of valuable established trees.

6. Splice grafting

A long slanting cut is made in both scion and root stock which are later tied together.



7. Bark grafting

The bark of the root stock is spit vertically and the prepared

BUDDING

This type of vegetative propagation the bud or scion is united with a seedling or a mature tree.

TYPES OFBUDDING

1. T-BUDDING

A t-Shaped cut is made on the back of the root stock and a bud is made on the back of the root stock and the bud fitted in

2. PATCH BUDDING

A rectangular piece of bud is cut of the root stock. A matching piece of bark with a bud is cut from the bud wood and matched into the prepared root stock.

3. TOP BUDDING

Buds from young plants are inserted at desired location on the stock and after setting the original branches are cut.

LAYERING

This involves inducing a part of plant usually a branch to produce roots while still attached to the mother plant.,

TYPES OF LAYERING.

1. SIMPLE LAYERING

This involves bending a stem and covering it with soil to produce roots.

2. TIP LAYERING

The whole shoot is bent and covered in the soil

3. COMPOUND LAYERING (SERPENTINE)

This is achieved by bending a stem several times and sometimes at a point of covering.

4. MOUNT / STOOL LAYERING.

A stem is cut just above the ground and the under shoot starts

5. TRENCH LAYERING

Here a trench is dug near the plant an a branch is layed on the trench to facilitate root development.

6. AIR / MACOTTING LAYERING.

The bark of a tree is open at a point and a wet mass is placed around the ring bar to keep it open. This stimulates root to develop at that point.

Assignment:

Define Dormancy
Causes
Correction
Methods used for testing seed viability.

CROP BREEDING / IMPROVEMENT

This is a process of changing crops genetically to suit man's needs of food, easy harvesting etc.

Or

It's a directed adjustment of crop plants to fit specific environment and production practices.

METHODS OF CROP BREEDING

1. MASS SELECTION

Here in breeding plants are selected basing on the individual character and these are used in the breeding programme.

2. BULK BREEDING

Products of F1 are grown in bulk before making a single plant selection depending on their performance.

3. PEDIGREE BREEDING

This is the most used method and its based on the performance of the ancestor and close relatives.

4. SINGLE DESCENT

Here one seed from F2 or F3 is used as a parent for the next generation.

5. RECURENT SELECTION

This is whereby the best individual resulting from a first selection cycle are crossed to generate the materials for the next selection cycles.

AIMS OF CROP BREEDING / IMPROVEMENT.

1. To increase crop yields so as to save the problem of hunger and food shortage.
2. To increase the nutrient content of the crop product to solve nutrient deficiency in consumers.
3. Produce better size and colour of fruits / seeds that can attract consumers.
4. To reduce the gestation period of a crop so as to solve food shortage.
5. Conferring disease and pest resistance in crop.
6. Production of crops that can tolerate adverse environmental conditions like drought, low soil fertility, high temperature.
7. To change growth characteristics of a plant in order to suit harvesting spraying and weeding.
8. to improve on the short life of the sowed crop production
9. To improve on seed viability character in plants so that there is no wastage of seeds during planting.
10. Improving the taste and flavour of certain crop products.
11. To produce crop products that is easy to prepare as food for consumers.

CROP PROTECTION

Weeds, Pests and Diseases

Weeds

A weed is a plant growing where its not wanted or a plant out of place or a plant whose usefulness has not been established

Characteristics of weeds

i. Can grow in poor soils where crops cannot easily survive
ii. Produce seeds that can germinate even when not mature
iii. Some are parasitic to crops which increases their chances of survival
iv. Weed seeds can remain viable for a very long period of time
v. Most weeds are less palatable to animals hence not destroyed during grazing
vi. Most can tolerate adverse weather conditions like drought which most crops can't
vii. Some weeds are resistant to control measures like chemical and physical controls
viii. Most are resistant to common pests and diseases that attack crops
ix. Some are vegetatively propagated which increases growth rate
x. Some weed undergo dormancy which helps it survive harsh conditions
xi. Weeds have a fast growth rate as compared to crops which helps in colonization fa new places
xii. Some weeds produce toxic materials that exclude crops from the area of growth
xiii. Weeds produce a lot of seeds increasing survival chances
xiv. Some have a short life cycle which increases rate of colonization

Effects of weed in crop production

i. Irritate man and animals by causing skin itching and scratches
ii. Reduce quality of farm products e.g love grass and blackjack in cotton
iii. Some are poisonous to livestock and can cause death
iv. Irritate digestive tracts of animals leading to diarrhea and reduced appetite
v. Taint milk leading to loss of quality
vi. Make navigation difficult and can cause accidents on water e.g. water hyacinth
vii. Harbour pests and diseases which later attack crops
viii. Reduce human efficiency during farm operation by causing allergies
ix. Increase production costs on the farm since money and time have to be spent during control
x. Lower crop yields by out competing crops for nutrients
xi. Block water pipes and irrigation channels increasing costs of water management on the farm
xii. Obstruct power lines and rail roads which may cause accidents

Positive impact of weeds in crop production

i. Some can be eaten as food for both livestock and man
ii. Some are a good source of herbs used in making medicine
iii. They decompose and form organic matter in the soil
iv. Reduce evaporation rate of water from the soil
v. Protect soil from erosion
vi. Can be used in mulching crop gardens

Classification of weeds

According to life cycle;

a) ***Annual weeds***; these complete their life cycle with in a year e.g. wild finger millet, love grass, black jack, MacDonald weed, oxalis, amaranthus, goat weed, double thorn, black night shade and milk weed
b) ***Perennial weeds***; these complete their life cycle in more than a year. Couch grass, spear grass, wandering Jew, Nile cabbage, thorn apple, Sodom apple, nut grass, tick berry e.t.c.

According to habitat;

a) ***Terrestrial weeds***; these are weeds growing on land. They form the majority
b) ***Aquatic weeds;*** these are found growing in water e.g. Nile cabbage, water hyacinth, water lilies, water lettuce, and water weed (*Elodea spp*)

According to morphology;

a) ***Erect weeds***; these grow up right like Sodom apple, black jack, thorn apple, e.t.c.
b) ***Creeping weeds;*** these grow on soil surface like star grass, wandering Jew,
c) ***Broad leaved weeds;*** these have broadleaves. They are mainly dicots like Sodom apple, thorn apple, blackjack, tick berry, wandering Jew, milk weed, amaranthus, goat weed, e.t.c.
d) ***Narrow leaved weeds;*** these have narrow leaves. They are mainly grasses that are monocots like couch grass, star grass, nut grass, spear grass, love grass

According to Physiology;

a) **C-3;** these use the C3 pathway in the utilization of carbondioxide during photosynthesis. They form the majority of broad leaved weeds
b) **C-4;** these use the C4 pathway in carbondioxide utilization during photosynthesis. They are mainly grasses with narrow leaves like spear grass and couch grass.
c) **Crassulacean Acid Metabolism (CAM);** these weeds use such a path way during their photosynthesis

According to botany;

This classification can be based on

Class

Order

Family

Genus

Species

Weed control methods

1. Preventive / legislation
2. Cultural
3. Mechanical
4. Chemical
5. Integrated weed management

Preventive method;

This is where measures are taken to prevent the introduction, establishment and spread of specific weeds in a non-infested area.

The following measures are taken in the control of weeds;

a) Use of weed free seed during planting
b) Use of weed free manures
c) Giving animals weed free hay
d) Using machinery which is weed free
e) Keep areas around the gardens and farm weed free
f) Not allowing weeds to reach seed stage

Merits of the method

a) Maintains weed population below injurious level
b) Ensures a weed free environment for proper crop growth
c) No disturbance of soil hence preservation of soil structure
d) Reduces weed spread in an area
e) No wastage of time and Labour in weeding
f) Does not create resistance in weeds.

Cultural weed control

It's the modification of general farming practices to reduce the impact of weeds

The modifications may include the following practices;

1. Crop rotation; this break the life cycles of parasitic weeds hence controlling it.
2. Proper spacing; it denies weeds access to enough light and space hence controlling it

3. Mulching; cuts off light supply to the weed seedling hence controlling weeds
4. Flooding; it suffocates the weeds by denying it oxygen supply resulting into death
5. Timely planting; this gives the crops an early and healthy start which enables it to out compete the weeds.

Mechanical/ physical weed control

It's where physical energy is used in the control of weeds. It may involve the following

- Hoeing weeds
- Mowing weeds
- Ploughing weeds
- Burning weeds
- Cutting weeds
- Slashing weeds
- Uprooting weeds
- Exposure to heat or flaming

Merits of mechanical weed control

- No use of chemicals hence no environmental pollution
- Burial of weeds helps in providing organic matter after decomposition
- Improves water infiltration by breaking soil crusts
- Tilling soil can improve aeration and tilth
- Depletes weed seed bank
- Its fast at weed control once carried out properly

Limitations

a) Its difficult to control weeds in rows
b) Increases water and organic matter loss in soil
c) It can easily lead to loss of soil structure with repeated operations
d) Dust may be raised in dry soil leading to pollution
e) Weeds may be exhumed leading to fast growth
f) May increase Labour costs on the farm hence increased production costs

Biological control

It's the use of natural enemies of certain weeds in controlling their growth and establishment

Advantages of biological control

a) Usually permanent hence control weeds continuously
b) It does not require additional inputs
c) Does not have side effects like pollution
d) Organisms are always host specific
e) Biological agents are self dispensing
f) After establishment, no additional inputs are required

Limitations

a) Its slow at controlling weeds
b) Establishment may fail leading to losses
c) Some attack crops causing loss
d) They require a high initial cost
e) Cannot completely eradicate the weeds
f) Results are not guaranteed

Chemical weed control

It's the use of herbicides in the control of weeds. Herbicides are agricultural chemicals that control plant growth

Classification of herbicides

Classification according to use

1. **Selective herbicides**; these kill or impair growth of certain plant species while sparing others. Examples of selective herbicides; Atrazine, Simazine, cotorum, 2, 4-D, MCPA, and MCPP
2. **Non selective;** these kill indiscriminately all plants they come into contact with i.e kill both crops and weeds. Examples; Glyphosate, Paraquat (Gramoxone), Diquat, e.t.c.

Classification according to mode of action

1. **Contact herbicides**; these kill any plant tissue they come into contact with whether for the crop or weeds. They are applied on foliage of weeds. Examples are; Paraquat, Bentazone, Propanile.e.t.c.
2. **Translocated or systemic herbicides**; these are absorbed by stems, leaves or roots and move through vascular system to plant organs where they exert their effects. Examples; 2,4-D, 2,4-T, Atrazine, Simazine, Cotorum, Diuron, Dalapon, Dicamba, MCPA, MCPP, e.t.c.
3. **Soil sterilants;** these prevent growth of all plant (weeds and crops) once in soil at high concentrations. They are mainly used at rails roads and pipelines. Examples are; Diuron, Bromacil, Simazine, e.t.c.

Classification according to time of application

1. **Pre-planting herbicides;** these are applied before the crop is planted. Such herbicides are mainly non-selective hence must be applied in this way to reduce crop damage. Examples are; Glyphosate, Paraquat (Gramoxone), Diquat, e.t.c.
2. **Pre- emergence herbicides**; these are applied before emergence of crops or weeds. They prevent seedlings or seeds of weeds from to establish. Examples are Paraquat, Diquat and Atrazine, e.t.c.
3. **Post-emergence herbicides**; these are applied crop germination and establishment. They are mainly selective herbicides that may not easily harm crops. Examples are; MCPA, 2,4-D, Atrazine, Simazine, e.t.c.

Advantages of using herbicides in weed control

1. It's very effective in controlling stubborn weeds like couch grass
2. Reduces tillage of soil hence conserving soil structure and moisture
3. It requires less Labour hence can reduce production costs
4. Herbicides can be easily applied in gardens where crop morphology does not allow use of mechanical means
5. Use of pre-emergence herbicides ensures a weed free environment hence high crop yields
6. Reduces chances of destroying crop roots since it does not involve tilling land
7. Weed free environment results into high quality and quantity of crop produce

Limitations of herbicide use

1. Herbicides are expensive to buy
2. They are poisonous to man and livestock hence difficult to store
3. Some persist in soil and cause environmental pollution
4. They require skill to apply
5. Some can be absorbed by crops and concentrated in crop products eaten by man
6. Some are not readily available in rural places where most farmers are found
7. can be washed into water bodies and kill aquatic organisms

Precautions to take when using herbicides (Crop, self and environment)

1. Apply the recommended rate to reduce damage to crops
2. Apply at the correct stage of weed growth for effectiveness
3. Do not apply during rain or when it is threatening to rain since the herbicide can be washed off
4. Avoid spraying during a windy weather since the herbicide can be blown off the weeds reducing effectiveness
5. Wear protective clothes during application to protect your self

6. Do not eat or smoke while spraying since you can easily take in the herbicide
7. Dress open wounds before handling herbicides
8. Herbicide containers should be properly disposed off in pit latrines to reduce chances of environmental pollution
9. Do not contaminate the food with herbicides
10. Do not pour left over chemicals in water sources
11. Apply the correct doze to prevent creation of resistance
12. Do not open blocked nozzles of sprayers using your mouth
13. Empty containers should be burnt disposed in pit latrines
14. Always use biodegradable herbicides to protect the environment
15. do not use the herbicides continuously to reduce soil contamination

Ensuring effectiveness of herbicides

1. Apply at the correct recommended rate i.e. correct concentration
2. Apply at the correct stage of weed growth i.e. apply when weeds are still young
3. Ensure that the weeds are fully wetted
4. Do not spray during a windy weather since the herbicide may be blown away from target area
5. Do not apply during rain of when it is threatening to rain since the herbicide can be washed off
6. Apply at the correct stage of crop growth to reduce damage to crops
7. Ensure that the herbicide cannot affect crop produce once applied
8. Always apply the correct herbicide for the right weeds
9. apply herbicides to weeds when the soil has enough moisture to encourage translocation of herbicides

PESTS

A pest is an organism that damages or causes harm to man, his animals, crops or possessions.

Important terms in pest management

Economic pest; this causes recognizable damage of about 5 to 10%

Economic damage; damage done to crops by pests that warrants artificial control

Economic injury level; it is the lowest pest population that can cause economic damage. It varies from pest species depending on;

- Mode of feeding
- Stage of crop growth
- Stage of pest growth
- Season of the year
- Part of crop attacked

Economic threshold; pest population density at which control measures should start to prevent an increasing pest population from reaching **economic injury level**

Pest complex; it is where a crop is attacked by pests and diseases at the same time.

Pest classification

- Key pests; pests whose population usually remains above the economic level e.g cotton boll worms
- Occasional pest; these occur in certain regions at specific periods e.g, Jassids, aphids, e.t.c.
- Migrant pests; these are non residential and appear periodically for a short time e.g army worms, locusts, e.t.c.
- potential pests; these cause no significant damage under the conditions currently prevailing in the agro-system e.g red banded leaf roller
- monophagous; feed on a particular species of crops e.g rice
- oliphagus ; these feed on various species of crops from the same family
- polyphagus ; these feed on various species of different family
- piercing and sucking pests; these pierce crop tissue and suck fluids. E.g Thrips, aphids, scales, mealy bugs, cotton stainers and seed bugs, cotton leaf hoppers,
- Biting and chewing pests; these have strong mouth parts that they use to bite and chew crop parts. Examples are grass hoppers, locusts, caterpillars, rodents, weevils, bean bruchids, e.t.c
- Field pests; these destroy crops while in the garden. They include monkeys, rodents, birds, stalk borers, caterpillars, weevils, cotton stainers, termites, e.t.c
- Storage pests; these destroy or damage crop produce in stores. Examples are bean bruchids, maize weevils, red flour beetle, e.t.c.

Damage caused by pests to;

a) growing crops
b) stored produce

Growing crops

- Eat planted seeds in soil reducing viability
- Eat crop roots causing plants to fall or wilt
- Eat crop leaves reducing photosynthetic capacity of crops hence yield
- Tunnel through stems weakening it
- Make holes in root tubers leading to rotting
- Suck crop sap leading to wilting
- Can eat crops completely
- Can transmit crop diseases
- Eat crop flowers causing low yield
- Bore into fruits and causes rotting
- Scratch fruits reducing their quality

Stored produce

- Eat produce completely reducing quantity
- Bore into stored seeds reducing quality
- Destroy endosperm hence reducing seed viability
- Cause bad smell in stored produce
- Deposit feaces in produce reducing quality
- Promote rotting of produce
- Destroy containers in which produce is stored
- Discolour produce leading to loss in quality
- Cause wet heating of produce
- Reduce nutrient level of stored produce
- Mix up produce lowering quality

Effects of sucking pests on crops

- Transmit pathogens to crops
- Inject toxic saliva into crops affecting growth
- Create entry points for pathogens into crops
- Suck sap from crops causing wilting and stunted growth

Indirect effects of pests in crop production

- Cause famine and suffering to humans by destroying food crops
- Increase costs of production in agriculture through buying pesticides
- Cause stunted growth in crops
- Reduce quality of crop products affecting prices
- Cause annoyance to farmers
- Can cause poverty to farmers
- Chemical control of pests can cause environmental pollution
- Some new pest species can come up when chemicals are used to control pests

Pest control

Factors considered before controlling pests

1. Pest population; high population requires immediate intervention
2. Reproductive rate of pests; high rate of reproduction may mean high pests population in a short time
3. Part of crop affected; pests that attack vital parts of a crop like flowers must be controlled immediately
4. Crop response to attack; when a crop shows a high response, then control must be immediate
5. Feeding habits of pests; biting and chewing pests cause a lot of damage hence must be controlled immediately
6. Presence of pest predators; once a pest has predators, artificial control may not be necessary.
7. Weather conditions; harsh weather may not favour pests hence in such conditions control may not be necessary
8. Pest mobility; highly mobile pests like those that fly can spread fast hence control is urgent

9. Presence of alternate plants; during control, alternate hosts must be eliminated as well.
10. Cost / benefit analysis; control must not be more expensive in relation to the cost of produce

The following precautions should be taken to have successful pest control

1. Should have good knowledge of pest classification and behavior
2. Make good pest sampling techniques
3. Should have good knowledge about pest predators
4. Know the type of food eaten by the pest
5. Know the pest habitat
6. Know the stages of pest development
7. Consider economic damage of the pest
8. Control pests at the favorable weather conditions

Chemical pest control
This is the reduction or prevention of pest damage by use of chemicals to attract, repel or poison pests.
Merits of chemical pest control
It is quick at controlling pests
Chemical application is standardized hence easy to use
The method does not require action from the community
Broad spectrum chemicals are economical to use
It is labor saving
It is very effective in killing pests

Demerits
Chemicals can pollute the environment
They are expensive to buy
Some can kill pest predators increasing pest populations
They require regular application
Chemicals create resistance in pests against pesticides
They may require a lot of skills to use

Characteristics of a good pesticide
1. Should be toxic to pests
2. Should not harm pest predators
3. Should be harmless to livestock
4. Must be reasonably persistent in soil to stop continuous application
5. It should be harmless to crops
6. Should leave no taints or residues on crop products
7. Should be suitable for practical formulation
8. Should be cheap to buy

Classification of pesticides
According to mode of action;
Stomach poisons- these are eaten then kill the pest. They are good for sucking pests

Contact poisons- can enter the body system through the skin or cuticle
Fumigants – chemicals are carried in air and breathed by pests. They are good for soil pests and those in crevices
Attracters – these are pheromones that attract pests so that they can be killed
Repellants- repel pests from one area or crop

According to group of pests controlled
Insecticides- kill insects
Acaricides – kill ticks
Fungicides- kill fungi
Herbicides – kill weeds
Nematicides – kill nematodes
Virulants - kill viruses

According to origin of the chemical
Botanicals are derived from plants like pyrethrum
Chlorinated hydrocarbons are organic compounds with chlorine attached on their bonds. They were the first to be developed and include DDT (Dichloro diphenyl Trichloroethylene), Aldrin, Lindane, methomyl, e.t.c.

Cultural pest control

It is the reduction of pest damage through the manipulation of agricultural practices that are normally applied in crop growing. The common cultural practices that control pests are;

1. Using planting materials that are free from pests to control spread and establishment
2. Removal of infected crops from the garden to minimize spread of pests
3. Practicing crop rotation that breaks the life cycle of pests
4. Planting crops on time so that they can escape pests that come late in the season
5. Timely harvesting which reduces pest damage to crop products
6. Planting pest resistant varieties of crops. Resistance can be pseudo or real.
7. Use of trap crops that help in eliminating the pests
8. Practicing close seasoning where community can be easily mobilized
9. Mulching the gardens to control pests like the banana weevils
10. Quarantine measure that reduces spread of pests from one place to another
11. Proper drying of crop produce to reduce pest damage during storage
12. Practicing inter cropping that may involve crops that produce hormones to scare away pests
13. Application of organic manures may kill some soil pests like nematodes
14. Flooding can suffocate and kill some pests
15. proper spacing of crops that may discourage aphids

Advantages of cultural pest control

1. It is continuous making the method economic
2. It is cheap compared with other methods like chemical and physical

3. Can be easily integrated with other control methods
4. Does not pollute the environment
5. Cannot develop resistance in pests
6. The practices can improve soil properties like soil structure, fertility, e.t.c.

Limitations of cultural pest control

1. The measures cannot eradicate pests but keep population at optimum
2. The method does not have dramatic results hence farmers are not easily convinced that it works
3. Requires maintenance of practices for effectiveness
4. Most practices are aimed at one pest
5. May require a lot time and energy to apply
6. May not address the problem of pest outbreak since it is slow
7. It is not standardized hence difficult to apply

Physical pest control

It is the reduction of pest damage to agricultural produce through the use of special physical and mechanical measures. It is the oldest and most primitive method of pest control. Physical means of pest control are;

1. Hand picking and killing. It is done with the less mobile pests that are big enough to be seen by our eyes
2. Construction of physical barriers like trenches to control caterpillars
3. Use of extreme conditions to kill or scare away pests
4. Use of electro magnetic waves that can kill pests
5. Use of irritating sound to scare away pests
6. Dehydration of pests using sand, ash or salt.

Advantages

1. Pests are destroyed completely
2. It allows the farmer to assess the pest situation on crops
3. Does not pollute the environment
4. Cannot create resistance in pests
5. It is cheap where area to be covered is small
6. Control methods are easy to learn and use

Disadvantages

1. May require a lot of labor for large plantation
2. It is not effective on highly mobile pests
3. It is time wasting

Biological pest control

It is the reduction of pest damage to crops by using natural enemies

Merits

1. It is environmental pollution free
2. No development of pest resistance
3. Pest population does not blow out of proportion
4. Does not affect pest predators

5. It is self adjusting hence a farmer does not need to think about it
6. It is a cheap method of pest control

Demerits

1. It is slow in operation
2. Biological agents may attack crops or spread disease
3. It may not eliminate the pests completely
4. Biological agents may fail to establish

Characteristics of a good biological agent

1. Should have a high searching ability for the pests
2. Must be host specific
3. Should have a high reproduction rate
4. Should be easy to multiply artificially
5. Must attack pests at the correct stage
6. Should not attack crops

Integrated pest management (I.P.M.)

It is the development of a set of practices that maintain pest populations at a level that cannot cause economic loss to the farmer.

Characteristics of IPM

1. It does not have set packages for every situation
2. It emphasizes a holistic approach to pest control
3. It allows existence of a pest with in a balance
4. It emphasizes minimum intervention with pesticides
5. It is not a universal solution to crop protection needs
6. Chemical control is used as a last solution
7. It requires understanding of systems and dynamics of pest control

Advantages of I.PM.

1. Its cheaper since it utilizes natural factors
2. More environmental friendly since it discourages use of chemicals
3. Traditional farmers can use it since it involves a mixture of traditional and modern methods of pest control
4. Cultivates a spirit of self reliance in pest control
5. It has the potential of offering permanent solution to pest problem

Constraints

1. Demands a detailed understanding of the present agro-ecosystems and their dynamics in response to intervention
2. It is difficult to develop standard packages that will suit every farming system
3. Results are not dramatic hence farmers cannot be easily convinced
4. Farmers are often ill equipped with knowledge and means to institute IPM
5. A holistic approach to IPM is difficult to realize due to limited knowledge

Crop diseases

A disease is a physiological disorder or structural abnormality which is harmful to a crop.

Causes of diseases in crops

1. Pathogens; bacteria, fungi and virus can cause diseases in crops
2. Mineral deficiency; this causes disease conditions like chlorosis, stunted growth, e.t.c.
3. Wind; it causes flattering and breaking of plant stems
4. Inadequate light; it causes etiolation in crops
5. Drought or water stress; causes crops to wilt and die
6. Hail damage; it bruises crop parts and destroys crop leaves completely
7. Water logging; excess in soil can cause wilting in some crops due to limited root development and air
8. Chemical effects; herbicides or pesticides used wrongly can scorch crops
9. Air pollution; it causes disease symptoms in crops

Signs of disease in crops

1. Cause **rotting** of crops
2. Causes **wilting** of crops due to blockage of xylem
3. Causes **hyperplasia**; abnormal fast rate of cell division
4. Causes **hypertrophy**; abnormal enlargement of cells leading to galls and warts
5. **Chlorosis**; yellowing common to crops with root or vascular diseases. Virus disease and nutrient deficiency can cause chlorosis
6. **Etiolation**; extended growth due to excessive or diseases like Bakanae disease of rice
7. **Stunting or dwarfing**; viral and bacterial diseases like Ground nut rosette and tomato bushy stunt. General nutrient deficiency and root diseases can cause stunting
8. **Anthracnose**; dark, sunken, necrotic spots or patches with raised borders on leaves or fruits
9. **Blights**; sudden and fairly extensive shriveling and death of certain areas of the plant. Can be caused by fungus and bacteria
10. **Cankers;** localized open sunken wound with raised margin usually found on wooden crops
11. **Damping off**; basal rotting of seedlings causing collapse and death
12. **Leaf spots**; limited areas of necrotic tissue. Spots can be circular, lenticular, angular, e.t.c.
13. **Mildews**; mold growth over leaf surface
14. **Rots;** necrosis of a large area of tissue on leaves, stems, roots, e.t.c.
15. **Rusts**; powdery sporing pustules on the leaves of stems usually yellow brown or orange

16. **Leaf curl;** malformation of the leaf lamina due to irregular formation caused by pathogens.
17. **Smuts**; black, powdery spore masses are produced on various plant parts.

Spread of disease

- Vectors like leaf hoppers, white fly, and e.t.c.
- Erosion water
- Wind
- Planting material/ seeds
- Contaminated fertilizers
- Contaminated soil
- Garden tools
- Through pollen or pollinating agents
- Through irrigation water

Common symptoms viral diseases

- Abnormal curling of leaves
- Chlorosis
- Stunted growth
- Abnormally short internodes (rosetting)
- Poor yield
- Mottling of leaves
- Yellow streaks

Control of crop disease

- Crop rotation
- Planting resistant varieties
- Removal diseases crops from the garden
- Proper weed control
- Proper spacing
- Hot water treatment
- Spraying with chemicals like fungicides
- Planting disease free seeds
- Destroying alternate hosts
- Close seasoning
- Quarantine measures
- Timely planting and harvesting

EFFECTS OF CROP PROTECTION MEASURES ON THE ENVIRONMENT

- Herbicides and pesticides pollute water sources
- Herbicides and pesticides kill important soil living organisms reducing decomposition rates in soils
- Continuous tillage of soil destroys the soil structure
- Use of biological agents may introduce new pests in the environment
- The chemicals can be absorbed into crop tissues and poison consumers

- Use of polyethene papers in mulching can pollute the soil and reduce water infiltration
- under doze of pesticides and herbicides creates resistance to control amongst target organisms
- Broad spectrum pesticides kill pest predators as well and this increases the number of pests in the environment
- continuous use of fertilizers alter the soil pH that affects soil fertility
- water pollution can cause death to aquatic organisms

Precautions taken towards environmental protection while controlling pests, weeds and diseases.

- Use the correct dozes of the agrochemicals
- Use the right chemicals at all times
- Dispose off empty containers correctly
- Reduce the level of tillage by practicing conservation farming
- Left over chemicals should be poured in pits
- Empty containers should never be used to carry food items
- Use biodegradable agro-chemicals

PASTURES

TERMS USED

1. **Pasture** - This is a fenced area demarcated forage plant usually improved and on which animals are grazed.
2. **Fodde**r – This is a grass or legume that is cut and carried to the stalk for in door feeding.
3. **Forage** – This is a plant grown primarily for feeding livestock.
4. **Hay** – This is feed produced by hydrating green forage to a moisture content of 15% or less.
5. **Silage** – This is forage preserved in a succulent condition by partial formation.
6. **Palatability** – This is the relative attractiveness of feed to an animal.
7. **Herbage** – This refers to leaves, stems and other succulent part of forage plant that animals can feed on.
8. **Stocking rate** – This is the number of animal grazing in unit area of pasture land irrespective of reliable or available herbage.
9. **Carrying capacity** – This is the number of animals a given pasture is able to support for a given period of time.

TYPES OF PASTURES

There are two main types of pasture i.e.
Natural
Ley

NATURAL PASTURE

This is open area with a dense cover of native grasses and other plant species.

ADVANTAGES

- forage plants found in natural pasture are well adapted to natural condition hence can survive even under poor management,
- Natural pasture contains a variety of forage plant needed in the animal diet.
- They are found in areas that are difficult to cultivate hence help in the utilization of such idle places.
- They can support a large population of local livestock species like goats, sheep, and cattle.
- They are cheap to maintain since they do not require a lot of care.
- They require fewer inputs during improvement.

DISADVANTAGES

- They are less productive in terms of herbage yields and nutritive value.
- The grasses mature very fast becoming stemy and coarse hence reducing palatability and nutritive value.
- They are usually grazed communally hence high chances of more livestock using it leading to overgrazing.
- Due to poor management of natural pasture livestock diseases spread very fast from herd to herd.

LEY PASTURE

These consist of improved grasses and legumes that provide high quality forage. Ley pastures are used for intensive farming and particularly for dairy cattle.

LIMITATIONS

1. High cost of establishment i.e. money is needed to prepare the land, buy seeds and fertilizers.
2. Lack of viable seeds – seeds are not readily available on a commercial basis for Ley pastures.
3. Poor quality animals – Most farmers rear poor quality animals which cannot give profitable returns to cover the cost of leys.
4. Poor managerial skills – Most farmers lack basic knowledge and skills of managing Ley so that they can be productive for a long period of time.
5. Poor soil – Most farmers are not willing to surrender their fertile soil for Ley pasture production.
6. Unreliable rainfall – Ley pasture production requires rainfall which is not less 800mm annually and must be well distributed.

IMPORTANCE OF PASTURES

1. They provide organic matter to the soil after rotting.
2. They provide a wide range of nutrients to grazing animals.
3. They help in utilizing idle land.
4. Deep rooted pasture plants recycle plant nutrients from deeper layer to soil surface for rooters to use.
5. They can break life cycle of pest when planted in a rotation with crops.
6. They can reduce water evaporation from the so acting as a cover.
7. Pastures are the cheapest source of feeds for animals

8. The root of pasture plant will bind soil particles together hence reducing soil erosion.
9. Pasture plant, particularly legumes improves the soil fertility by fixing nitrogen into the soil.

IMPROVEMENT OF NATURAL PASTURES

1. Fencing - The area should be fenced to exclude wild animals and intruders.
2. Remove bushes and dense tree canopy so that the pasture grasses can receive enough light.
3. Weeds control – Poisonous and notorious weeds should be removed.
4. Provision of water to animals – Watering points should be well distributed to avoid over grazing and trampling on pastures in some places.
5. Erosion control – Stolonferous grass spp should be planted on bear surface or in over grazed area to reduce soil erosion.
6. Over sow – this is the introduction of improved forage spp more especially legumes in natural pasture to improve nutrient content.
7. Control grazing / rotational grazing / strip grazing – This encourages efficient forage utilized and reduces over grazing.
8. Establishing fodder bank that can be fed to animals when fresh herbage is scarce.
9. Distribute salt licks evenly in a pasture to stop animals from creating small path in a pasture as they move to the point with the licks.
10. Practice control burning so that all pasture with parasites are got rid of to give way for the young and nutritious forage.
11. Draining water logged area so as to encourage proper forage growth and control parasites

FACTORS TO CONSIDER BEFORE ESTABLISHING A PASTURE

1. Type of soil – A farmer should consider a good soil with a good ability to retain moisture
2. Topography – pasture land should have a gentle slope which allows easy use of machines during seed bed preparation and planting.
3. Climate – The area should have adequate rainfall with about 800mm during dry periods.
4. Planting materials – There should be good quality planting materials that ensure good pasture establishment.
5. Cost of production – The farmer should make sure that the expense involved in pasture establishment can be met from the income of the animals.
6. Availability of pasture seeds – The pasture under consideration should have readily available seeds with in the environment.

CHARACTERISTICS OF A GOOD PASTURE SPECIES.

1. It should be easy to establish hence reducing cost involved in replacing the seeds that failed to establish.
2. It should be able to provide herbage even in times of scarcity
3. It should be drought resistant. In order to meet this deep rooted species are always preferred.

4. It should be easy to manage i.e. easy to plant, weed and harvest.
5. It should be highly palatable so that the animals can take it.
6. Should match with the nutrient requirement of animal.
7. It should show a high resistance to grazing i.e. the species should be able to regenerate after grazing and persist for atleast three years.
8. It should be highly resistant to pest and diseases that can attack the pasture.
9. Should be able to produce a large quantity of dry matter in a year for the animals to graze on.
10. It should have a suitable height from the ground to allow easy grazing by the animal.
11. It must be a pasture that can be easily mixed with other pasture species without having any effect on them or being affected.
12. It should have readily available seeds that can be used for propagation.

TYPES OF PASTURES

Pasture is divided into two broad groups. i.e.

- Pasture grasses
- Pasture legumes

Examples of pasture grasses

- Guinea grass - ***Panicum maximum***
- Rhode grass - **Chloris *gayana***
- Congo Signal grass - ***Brachiaria ruziziensis***
- Elephant grass - ***Pennisetum purpureum***
- Kikuyu grass - ***Pennisetum clandestinum***
- Nandi grass - ***Setaria anceps***
- Thatch grass - ***Hyparrhenia rufa***
- Star grass - ***Cynodon dactylon***

Examples of common pasture legumes

- Green leaf Desmodium - ***Desmodium* intortum**
- Silver leaf Desmodium - ***Desmodium uncinatum***
- Stylo - ***Stylosanthes gracilis***
- Glycine - ***Glycine wightii***
- Centro - ***Centrosema pubescens***
- Lucerne - ***Medicago sativa***
- Clovers - ***Trifolium spp***

ADVANTAGES OF INCLUDING LEGUMES IN A PASTURE

1. They fix nitrogen into the soil hence improving soil fertility for other plant species.

2. They show a high resistance to drought hence can be relied on during the dry season.
3. They increase the palatability of the pasture since they are highly palatable.
4. Since they are deep rooted, they help in recycling plant nutrients for use by other plant species.
5. They reduce cases of bloat in animals since they are not very succulent.
6. A good number of them have broad leaves hence have the ability to control soil erosion.
7. The legumes supply protein to the animals which supplement the grass.
8. They give longer grazing period since they mature at different times.
9. They produce better quality and quantity of foliage for the animals.

ADAPATATION OF FORAGE PLANTS TO THE ENVIRONMENT

1. They produce very many feeds which increases their chances of survival
2. Their seeds are light hence can be easily dispersed by wind.
3. they can withstand defoliation and regenerate quickly
4. They have short life cycle hence able to utilize the shortest period of good conditions
5. some have thorns and hair which discourage animals from eating them
6. Some species produce chemicals which keep off animals
7. Some have under ground stem (rhizomes) which will sprout when the leaves and stems are destroyed.
8. Some grass seeds posses hard seed coat that can not be destroyed by the animal digestive system.

CONSERVATION OF HERBAGE.

Herbage can be conserved into two major ways i.e.

- Hay
- Silage

HAY

CHARACTERISTICS OF A GOOD HAY

1. Good hay should be leafy since leaves are richer in food value compared to other parts of the plant.
2. Should be prepared out of herbage cut at the stage near flowering when the plant is highly nutritious.
3. It should be green in colour since the green colour signifies the presence of Vit .A
4. It should be free from dust and moulds which reduce palatability
5. It should be soft and pliable for easy consumption by the animals.
6. It should be free from weeds and poisonous plants.
7. It should have a smell which is a characteristic of the plant from which it is made.

8. The moisture content of hay should not exceed 15% since high moisture may cause rotting.

FACTORS AFFECTING THE QUALITY OF HAY

1. The species of grass – some grass species produce high quality hay since they can be easily turned and have nutrient content.
2. Storage – Proper storage of hay by protecting it from rain and sunlight preserve the quality.
3. Stage of cutting the grass – Grass cut before flowering produces high quality hay than that cut after flowering.
4. Level of drying – Poorly dried hay becomes moldy and over dried hay lacks Vit. A

PROCEDURE OF MAKING HAY

1. Select a suitable plant species with high nutrient to be used in the making of hay.
2. Cultivate the plant species on a good soil where it can obtain the required nutrients.
3. Harvest the plant species just before flowering when it contains a lot of nutrients.
4. Dry the hay to a moisture content of about 15%
5. Tie the hay in bales and prepare it for storage
6. The hay should be stored in a place well protected from rain and sunlight to preserve the quality.

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SILAGE

This is the herbage cut before flowering and converted into succulent feed through the process of fermentation. It can be made from any succulent green material such as sweet potatoes vines, young maize, sunflower sorghum, young Guatemala grass and elephant grass.

N.B. High protein foliages mixed with starchy foliages in ratio 3:1 give well balanced silage.

THE PROCESS OF ENSILING (MAKING SILAGE)

1. Cut the grass when it is about to flower and incase of legumes when they have formed pods.
2. Chop the grass into small pieces of about 4cm long that can be easily packed.

3. Park the material in the air tight chamber (silo) and compress it to exclude air.
4. Add fermentable water soluble carbohydrates like **molasses** which provide energy to the microbe during fermentation process.
5. Add **urea** at a rate of 5Kg per ton so as to increase nitrogen content of the silage.
6. When the silage chamber is full, seal it off from the atmosphere to exclude air and water.
7. Allow the materials to ferment for Atleast three weeks
8. Monitor the temperatures in the silo to ensure proper fermentation. When temperatures drop, molasses should be added to provide energy to the microbes carrying out fermentation.

FERMANTATION PROCESS

a. The material is under fermentation through the action of lactobacillus bacteria.
b. Organic acids are produced and the major one being lactic acid
c. Lactic acid gives silage a good flavour, kills off the harmful microbes and acts as the preservative for silage.
d. The PH has to be low between 3.8 -4.3 and the temperature must rise to about 37.8^0C to encourage fermentation by lactobacillus.
e. If the temperatures are low, add more **molasses** into the silage.
f. Add water to lower temperature incase they are high.

N.B. Low temperature can be avoided by:

1. Partial drying of the material before ensiling to reduce moisture in the silage.
2. Filling the silage chamber rapidly but compressing the material lightly.
3. Sealing the silo immediately after the final packing to exclude air as much as possible.

N.B. Forage crops contain other species of bacteria such as *clostridium ssp* which convert sugars and lactic acid to butyric acid.

Butyric acid gives silage a foul smell and makes it less palatable.

FACTORS AFFECTING THE QUALITY OF SILAGE.

- The type of grass and legume species ensiled
- The stage of growth of the species ensiled
- The speed of ensiling
- The type and amount of additive used.
- Consolidation to exclude air from ensilage.
- The moisture content of the material ensiled
- The degree to which the temperature rises during ensiling.

Reasons for making silage

- For getting money
- Increase total amount of herbage produced per unit area
- Get feeds for use during periods of forage scarcity
- Conserve forage in succulent form

- Avoid forage wastage in periods of planting and abundance
- Increase number of livestock that can be kept per unit area
- Enables animals eat plant materials that they would not eat when fresh.

Advantages of silage.

- In increases the animal's appetite since it is very palatable and so increases an animal's intake of a feed.
- It is easier to store than the same quantity of hay since it requires less space per unit weight to store.
- The losses incurred during ensiling are less than those incurred in making hay.
- Many species that the animal cannot eat in fresh form can be eaten when ensiled.
- Under proper storage, silage can stay for several years without losing quality.
- Because the materials retain succulence, fire outbreaks during storage are avoided unlike in the storage of hay.
- There is increased efficiency of feed use since the animal rejects very little of the feed.

Problems of using silage.

- Some nutrients are lost due to seepage in the process of silage.
- Its more laborious
- The plant materials are difficult to compact effectively and some rotting is inevitable.
- It is expensive in terms of preservatives used.
- It requires large quantities of materials for it to be economical
- Poorly fermented silage has a bad smell that it may be introduced into the animal products.

How to reduce losses during silage making.

- Careful harvesting of the material to reduce losses of leaves and contamination by soil.
- Proper sealing of the silos to prevent re-entry of air into the silo.
- Proper fermentation of the material to exclude oxygen and acid fermentation.
- Proper chopping of the material to ensure proper fermentation.
- Wilting of the material before ensiling to reduce the moisture content and reduce the possibility of rotting.
- Addition of additives to increase the energy supply for the bacteria and preservatives.
- Quick use of the material once the silo has been opened to reduce the chances of spoilage due to exposure to the environment.

FORAGE UTILIZATION METHOD

- Continuous grazing
- Rotational grazing
- Zero grazing
- Deferred grazing.

- Strip grazing

a. Continuous grazing

This is an extensive system of grazing in which livestock remain on the same pasture for prolonged period.

Advantages of the system

i. Fencing costs are reduced or avoided completely.
ii. It allows animals to have free access to any part of the pasture
iii. No costs are involved in improving pastures.

Disadvantages

i. It allows selective grazing which can lead to pasture wastage
ii. It encourages the build up of ticks and internal parasites within the grazing place.
iii. It may result into under stocking or over stocking as plant growth and seasonal conditions change.
iv. Its difficult to control / diseases amongst animals since the system encourages communal grazing
v. Pasture improvement is extremely difficult as more people are involved in using the pasture.
vi. May easily result into overgrazing and destruction of pastures

b. Rotational grazing

This is where pastures is divided into paddocks and animals are allowed to graze in one paddock at a time until the herbage is uniformly grazed to a given height then moved to another paddock. High producers like lactating animals are allowed first into paddocks for it to graze the more nutritious herbage.

Advantages of rotational grazing:

1. Provides a uniform developed pasture due to uniform grazing
2. It allows maximum utilization of herbage by avoiding selective / spot grazing.
3. Forage yield is potentially higher since pastures are allowed to regenerate than in other systems.
4. Intervals between grazing allow for remediable practices like fertilizer application, weeding etc.
5. It's a good method used in the control of parasites like ticks, roundworms, liver fluke.

6. It reduces instances of over grazing and under grazing hence controlling destruction of pastures
7. It makes management practices easy as animals are confined in one place.
8. It allows flexibility in the use of pasture land since crops can be planted in the idle paddocks.
9. It can allow higher stocking rate of animals.
10. Controlled breeding is easy to practice since animals can be grouped according to sex

Disadvantages

1. It requires a high initial cost of establishing fences on pasture land.
2. Requires a high level of managerial skills in terms of repairing the fences, improving the pastures etc.
3. Fences can easily injure animals.
4 Over trampling on pastures by animals leads to wastage
5. May require a lot of Labour for repairing farm structures and managing animals

c. Zero grazing

This is where animals are confined in structures / stalls where they are fed on fresh forages cut on a daily basis.

Advantages:

1. Animals are protected from adverse Climatical conditions
2. Feed taken in by each animal is easily known hence easy to keep feeding records.
3. Its easy to identify sick animals since they are in close observation
4. Its easy to collect manure from the animals since they are confined in one place.
5. Disease spread is reduced since animals are not in contact with others from another herd.
6. There is high production since animals do not spend a lot of energy looking for pasture and water
7. Selective grazing and trampling on pastures is effectively controlled since animals are fed on pastures cut from the field.
8. Its easy to carryout management practices on animals under this system as animals are under confinement.
9. The system permits high stocking rate since a large number of animals can be kept on a small piece of land

Disadvantages:

1. The method is capital intensive i.e. requires a lot of capital for constructing animal structures and feeding
2. It requires a lot of Labour which can be used in collecting fodder, cleaning the stalls etc.
3. It cannot support a large number of animals
4. The system is applicable economically in places where market for milk is readily available to cover the costs involved easily.
5. It may lead to loss of soil fertility if manure is not taken back to the fodder garden.
6. The animals lack exercise which can affect their health.

d. Deferred grazing

This is where a certain paddock is set aside to allow the accumulation of standing hay which can be grazed on during periods of pasture scarcity

1. Pasture seeds are dispersed for pasture stand improvement
2. It provides herbage during periods of scarcity.
3. It allows pastures to develop greater root and crown which is important for subsequent re-growth.
4. The pasture can be used in the control of soil erosion.
5. It allows for natural establishment of pastures

Disadvantages

i. The pasture is not as nutritious as the fresh pasture hence a need to supplement it.
ii. Requires a large piece of land for practicing deferred grazing
iii. Does not permit high stocking rates

e. Strip grazing

This is where strips of fresh pastures are made available each day to animals by moving an electric fence forward.

The grazed area is sealed off for regrowth and excess pastures conserved.

Advantages

i. The animals enjoy fresh grasses each day
ii. The grass is eaten at its highest nutritive value
iii. Allows intensive grazing hence utilizing pastures efficiently
iv. It is highly flexible since it may allow more than one activity on the land

Disadvantages

i. Requires more Labour
ii. Requires more skills in using an electric fence
iii. Pastures may be destroyed as a result of overgrazing.
iv. Ground where animals pass is destroyed and lost since pastures may fail to grow there

Establishing a pasture

a) Clear the land to remove trees and bushes that may interfere with pasture growth
b) Prepare a firm (for moisture conservation), fine (to bring small seeds in contact with soil) and weed free (reduce competition for nutrients) seedbed by burning, ploughing, and harrowing
c) Apply fertilizers to the seed bed to improve soil fertility more especially phosphatic fertilizers for proper pasture establishment
d) Select good quality seed for planting depending on the animal's needs and environment
e) Treat the seeds to ensure uniform and proper germination by scarification, inoculation and pelleting
f) Sow the seeds shortly after the rains so as to take advantage of soil nitrogen made available by mineralization. Methods of sowing are drilling, broadcasting and row planting
g) Apply pesticides and fungicides to control pests and diseases in pastures

AGRO FORESTRY

This is the integration of trees in agriculture production

Importance of the practice

1. Trees increase out put from land in form of wood fruits, wood and fuel on top of crop and animal products
2. Trees can control soil erosion by increasing water infiltration and covering the soil surface
3. They can reduce hail damage to crops
4. Legumes improve soil fertility by fixing nitrogen into the soil
5. Rotten tree leaves improve organic matter content in the soil

6. Some trees are good source of animal feeds e.g. Lucerne
7. Trees can act as wind breaks reducing wind damage to crops and farm structures
8. Trees improve the micro climate of garden for proper crop growth
9. Some trees produce chemicals that discourage pests
10. Deep rooted agro forestry trees can recycle soil nutrients for crops
11. The mulberry tree provides food for silk worms

Adverse effects of trees in agriculture

1. Can compete with crops for soil nutrients which affects crop yield
2. Use up space meant for crops
3. Soil nutrient are lost in tree tissue as the trees are harvested
4. Some trees are poisonous to livestock and crops
5. Trees can provide habitat for pests that attack crops
6.

Factors that influence the farmer's decision to practice agro forestry

i. Availability of land for growing crops and raising trees at the same time
ii. Good land tenure system that will ensure proper tree ownership since trees take a long time to mature
iii. Availability of market for tree products within the area
iv. Clear tree ownership policy for the farmers
v. Love for trees by the farmers in an area
vi. Number of activities on the farm that may allow in tree production at the same time
vii. Knowledge of the farmer about tree management
viii. Availability of tree seeds needed for planting
ix. Enabling government policy through subsidies

Characteristics of an ideal agro forestry tree species

i. It should be multi purpose so as to be economical to produce
ii. Should be fast growing to meet the needs in time
iii. Should be deep rooted so as to recycle the nutrients
iv. Should not compete with crops for nutrients
v. Should be able to regrow fast after cutting
vi. Should be highly notorious and palatable as leaf fodder
vii. Should be preferably a legume that can fix nitrogen into the soil to improve soil fertility
viii. Should be able to produce more economic products like fruits timber and fuel
ix. Should be easy to establish and get rid of easily
x. Should have a light canopy that allows easy light penetration for the crops under it to use

Common agro forestry species and their uses

Fruit trees

Pawpaw *Carica papaya*
Mango *Mangifera indica*
Lemon *Citrus lemon*

Orange *Citrus sinesis*
Ovacado *Persea americana*
Guava *Psidium guajava*
Jack fruit *Artocarpus heterophyllus*

Shade trees
Cassia (yellow cassia) *Cassia siamea*
Cassia (golden cassia) *Cassia spectabilis*
Ficus *Ficus spp*
Wild cassava *Manihot glaziovii*
Tamarind *Tamarindus indica*

Pole and timber trees
Neem tree
Eucalyptus *Eucalyptus spp*
Musizi *Maesopsis eminii*
Markhamia (lusambya) *Markhamia lutea*
Pine *Pinus spp*

Fire wood trees
Mango
Citrus trees
Neem tree
Calliandra
Pine
Eucalyptus

Livestock feed/ fodder tree
Lucerne
Gliricidia
Calliandra
Sesbania

LIVESTOCK MANAGEMENT.

Livestock includes all animals kept on a farm for economic purposes e.g pigs, cattle, goats, sheep, camel, chicken, ducks; bees, pigeons, turkeys e.t.c.

Importance of Livestock.

- It's a source of income more especially when the animals are sold wholly by the farm.
- The livestock industry provides market to the agro chemical industry through the sell of drugs and feeds.
- Live stock are a good source of proteins for man in form of eggs, milk, meat e.t.c
- The livestock industry provides employment both directly to people working in leather turning industries and milk processing plants.

- Livestock provides manure which is rich in nitrogen and phosphorus to be used in crop gardens.
- Livestock have found a place in cultural and traditional ceremonies where they are being used as sacrifices.
- Some animals like the cattle, donkeys and the horses are being used as a source of Labour in transporting farm produce and ploughing.
- On the national level, live stock products like hides and skins are a good source of foreign exchange for the country which improves the economy.
- The live stock industry is a source of government revenue when taxes are levied on live stock and their products.

FACTORS DETERMINING THE TYPE AND BREED OF LIVE STOCK TO BE KEPT/LIVESTOCK DISTRIBUTION IN UGANDA

Climate:
The high temperatures of the day tend to discourage most of the exotic animals of European origin and such animals are limited to particular areas of Uganda with favourable environmental. Conditions

Pests and Diseases

The presence of pests like ticks and tsetse flies has limited the raring of exotic animals since they are more prone to tick borne-diseases like: East Coast fever, Red water, etc.

Availability of Feeds:
Animals like pigs require high protein feeds which are expensive for most of the farmers. This may discourage the rearing of such animals where feeds are not available.

Risk baring capacity of the farmers:
Most farmers in Uganda are peasants with low income. This means that such farmers can not easily take high risks of looking after high value exotic animals like Friesian cattle.

Level of skills and education among farmers:
Most farmers in Uganda are illiterate and have little knowledge on how to manage livestock like fish and bees. This will affect their choice of live stock and hence distribution.

The expected additional function of the animals:
Animals that have many functions will always be liked and their distribution in an area is high e.g. Cattle. Cattle can provide meat, milk, manure and Labour which other animals may not

Religion and traditional beliefs:

Some animals are viewed as unclean by certain religion and traditions e.g. The pigs among the Muslims. This meant that such people can't look after the pigs.

Capital:

In the presence of enough capital, a farmer can look after the highly productive exotic animals with less problems since he can raise all the necessary infrastructure like dips, perimeter fences, spray races e.t.c.

Government policy:

Enabling policy has led to an increase in the distribution of livestock in some places e.g. restocking of cattle some areas in Uganda like Teso with cattle.

Market:

The availability of market for certain livestock or their product in a particular area will increase their distribution and vice versa.

Availability of land

Cattle require enough grazing land and can only kept in large numbers in areas with vast land as compared to the densely populated parts

Historical background

The Bahima and Karimajong of Uganda have been cattle keepers throughout ages which makes it easy for them to look after cattle

CHARACTERISTICS OF THE LIVESTOCK INDUSTRY IN UGANDA

- The number of animals kept is unrestricted with most farmers preferring quantity to quality.
- There is very little attention given to the improvement of the pastures since they are grazed communally.
- The grazing time is limited as the animals are taken out to graze during the day and brought in the kraal at night.
- There is little planned mixed farming i.e. crop and animal units are rarely integrated.
- Breeding is rarely controlled e.g. animals mate when they are still very young and there is a lot of inbreeding.
- The watering places are very far away from the grazing places and animals spend a lot of energy walking.
- Generally the standard of livestock management in Uganda is very poor with no records kept at farms.

PROBLEMS OF THE LIVESTOCK INDUSTRY IN UGANDA.

Pests and diseases:

The tropical conditions favour the multiplication of the pests like tsetse flies and internal worms. These have caused a lot to farmers.

Lack of enough capital:

Most farmers in Uganda are poor and therefore can't afford expensive inputs like drugs, animal feeds e.t.c.

Breeding:
In Uganda most animals are mated when they are still young and there is a lot of inbreeding which will affect the quality and quantity of livestock products.

Poor Housing:
There is no proper housing for livestock in Uganda and the animals are left to sleep outside where they are exposed to advanced environmental conditions which will affect their products.

Poor Record Keeping:
Most farms in Uganda lack records of individual animals and the farms in general. This makes selection for breeding and culling difficult (removal of unproductive animals in the farm)

Limited Extension Services:
Most farmers do not receive enough information on livestock management from extension staff. This is because extension workers are far and are not well facilitated.

Poor Marketing System:
The markets for livestock and their products are still few and scattered with fluctuating prices which discourage the farmers.

Poor Pastures:
Most of the pastures graded by the animals are of poor quality which lowers animal production

Insecurity and cattle rustling;
Some places in Uganda are politically insecure which leads to loss of life and property hence discouraging live stock production.

Harsh Climatical conditions
Long drought leads to inadequate water and pasture which lower animal production

SOLUTIONS TO THE LIVESTOCK PROBLEMS.

- Extension workers should be facilitated so that they can give services to the farmers more especially those who are in remote areas.
- Provision of loans, farmers should be provided with loans more especially soft loans so that they have enough capital to improve on their infrastructures like fences, dips e.t.c.

- Artificial insemination should be encouraged so that farmers can maintain high quality animals which are more productive through the importation of semen.
- Marketing of livestock and their products should be organized so that farmers can easily get the information through the internet, news papers and farmers journals about the markets and the available prices.
- Settled grazing should be encouraged so that more attention is given to the animals for better production.
- The land ownership laws should be improved so that farmers can get access to land easily with fewer costs involved. Proper land ownership also encourages the development of that particular land.
- The paddock system of grazing animals should be introduced so that animals can be controlled to reduce over grazing, encourage mixed farming and improvement of the pastures.
- Routine vaccination of animals against killer diseases e.g. Rinder pest, ant swine fever, foot and mouth diseases. N.B: should be done by the Government to reduce the incidence of such diseases.
- Government should endeavour to subsidize agricultural inputs so that the farmer can enjoy a higher profit margin that can encourage them to develop their farms.
- Security should be maintained in all areas so that livestock farmers are encourage by reducing risks of property and life loss
- Valley dams should be constructed so as to solve the problem of inadequate water during drought.

CATTLE.

DIAGRAM OF A COW

Classification of cattle

Phylum; Chordata

Class; Mammalia

Order; Artiodactyla

Genus; Bos

Species; *indicus* (humped cattle)

taurus (hump less cattle)

- The immigrant cattle (long horned and short horned) are considered as ancestors of ***Bos taurus*** (European type of cattle) and the ***Bos indicus*** (zebu) type.
- These mixed at different times in different ways to create the sanga cattle which is the predominant type of cattle today.
- In East Africa, the sanga have been displaced by the zebu.

DIFFERENCES BETWEEN *Bos taurus* AND *Bos indicus* CATTI.E

***Bos taurus* /Exotic**	***Bos indicus* / Indigenous**
Don't have a prominent hump.	Have a prominent hump.
Rounded ears held at right angles with the head.	Have long dropping pointed ears.
Have a short and wide head.	Have long and comparatively narrow head.
Relatively large with the bull weighing up to 1000kgs	Relatively small with the bull rarely weighing exceeding 700kg.
The dewlap, umbilical cord and the brisket are small or absent.	Dewlap and brisket are extensively developed.
Have thick skin which is relatively tight.	Have a thin and loose skin.
Have large amounts of subcutaneous fat.	Have small amounts of subcutaneous fat.
Hair tends to be relatively long and rough	Hair is relatively short and smooth.
Legs tend to be short and are slow moving.	Legs are long and fast moving.
Mature more easily and reach full maturity at 4 years.	Slow maturity and reach full growth at 5½ years
Back line is straight	Backline is high at the shoulders, low behind the hump and higher over the pin bones.

Indigenous cattle

These are humped cattle of tropical origin. Examples are; Zebu, Brahmin, Sanga, Nkole and Boran

Characteristics of indigenous cattle

1. They are resistant to adverse Climatical conditions like high temperatures and drought
2. They can walk for long distances without losing condition
3. They easily convert poor pastures into milk and meat
4. They are tolerant to tick borne diseases like east coast fever
5. They have few problems of reproduction
6. They are cheap to buy and maintain
7. They are less productive in terms of milk and meat

The indigenous cattle are being kept for meat and milk by the communities in Uganda. Improvement of these animals is being carried out through upgrading with exotic cattle

Exotic cattle

These are hump less cattle that have been imported into east Africa from European countries. They are kept for milk and meat or both

- Examples of exotic dairy breeds; Friesian, Jersey, Guernsey and Ayrshire
- Examples of exotic Beef breeds; Galloway, Hereford, Charolais, Sussex, Aberdeen Angus, Lincoln Red, e.t.c.
- Examples of dual purpose exotic breeds; Red Poll, Dexter, Short horn, South Devon and Welsh Black

Characteristics of exotic cattle

1. They have a high growth rate
2. They are not resistant to tick borne diseases
3. They may reproductive problems
4. They cannot tolerate high temperatures and drought
5. They require high quality feeds for high production
6. They lose condition after walking for long distances
7. They require a high level of management
8. They are highly productive in terms of milk and meat

MANAGEMENT OF CATTLE

This is the care given to cattle to improve and maintain a high production.

A stockman is the person entrusted with the work of caring for livestock on a farm

Qualities of a good stock man

a) Should be kind to the animals by avoiding rough treatment that can cause injury and death to animals
b) Should know well the monthly or routine operations on the farm like drenching, vaccination to reduce risks of disease and death of animals
c) Should have a high ability of identifying sick animals and those on heat for prompt action.
d) Should be able to identify and remove dangerous objects from the farm to reduce injury to livestock
e) Must be able to keep good up to date records for reference purposes
f) Should be able to take correct decisions as and when required to reduce losses on the farm
g) Should be honest to reduce losses to the farm
h) Should be healthy and energetic so as to carry out work as and when required
i) Should be highly knowledgeable in livestock management to ensure high animal production
j) Should be able to do work on the farm under minimum supervision from the high officers

MANAGEMENT PRACTICES IN CATTLE

These are operations done on cattle to ensure high production. They include the following:

- Feeding.
- Branding
- identification
- Housing.
- Castration
- Dehorning.
- Grooming
- Casting / putting animals down
- Vaccination
- Hoof trimming
- Drenching / dehorning
- Restraining

1. DEHORNING:

This is the removal or suppression of horns on animals. Suppressing horn growth at an early stage is called **Disbudding**

Importance

- To make the handling of the animal move easy especially during drenching, castrating, ploughing e.t.c.
- To allow more animals to fit in space during transportation of the animals and even in kraals.
- To reduce injury which is may be caused by horned cattle to others.
- To prevent the destruction of farm structure like fences by animals that are horned.
- To beautify animals hence making them more appealing.
- It introduces uniformity in a herd
- Makes animals to grow faster as nutrients meant for horn development are used in growth

METHODS OF DEHORNING

The method used will depend on the age of the animal, farmer's skill and to some extent capital. Methods used in dehorning are;

- Use of caustic pencils or chemical dehorning
- Use of hot iron
- Use of dehorning saw
- Use of a rubber ring
- Use of dehorning wire
- Use of dehorning clippers

i) Chemical Method:

This is where caustic pencils or sticks are used in suppressing horns by rubbing it against the horn buds. It's done to young animals between 3-14 days of age.

Procedure

i. Restrain the calf using ropes and cast it down
ii. Clip the hair around the horn bud to expose it
iii. Rub the caustic sticks or pencils are against the horn bud until bleeding occurs
iv. Apply fly repellants and antibiotics on the wound created
v. Release the calf after the operation
vi. Do not allow the calf into rain for a few days for faster healing of the wounds.

ii) Hot iron method:

This is where a hot iron is applied on the horn bud to burn and kill the growing cells.

Procedure

i. Restrain the calf using ropes and cast it down
ii. Heat the iron in fire or gas until it's red hot.
iii. Apply the hot iron around the horn bud for about 10 seconds to burn the growing cells.
iv. Care should be taken not to go deep as it can damage the brain
v. Apply fly repellants on the wound created to keep away flies and stop the wound from becoming septic respectively
vi. The animal should be released after the operation
vii. Monitor the animal to ensure that it does not go under rain

iii) Use of a rubber ring;

A rubber ring is placed at the bottom of the horn bud which will stop blood supply to the horn and cut it off with in three to six weeks depending on the size of the horn. It is done on small horns at early age

Procedure

- Restrain the animal in a crush or using ropes
- Use an elastrator to stretch out the rubber ring
- Place the rubber ring at the base of the horn and remove the elastrator to release the rubber ring
- Release the animal after the operation

iv) Use of dehorning saws:

- This is used where the horns have grown up and is long enough. The horns are cut off near the base after restraining the animal.

Procedure

i. Restrain the animal using ropes and cast it down
ii. Administer a localized pain killer in the skin surrounding the horn
iii. Tie a piece of thin rope around the base of the two horns to control bleeding
iv. Cut off the horn at the base using a dehorning saw
v. Repeat the same procedure to remove the second horn
vi. Use a hot iron to seal the wound to stop bleeding.
vii. Apply insect repellants and antibiotics on the wound
viii. Release the animal after the operation and closely monitor it to assess the healing process

ix. Remove the ropes around the base after two days

v) Use of dehorning wire

This where a brittle wire is stretched and rubbed against a horn until it is cut off. The animal is restrained and the operation carried out

vi) Use of dehorning clippers

Dehorning clippers are tools with open blades that remove horns by cutting. They are used in the removal of large horns

2. CASTRATION:

It's the practice of rendering male animals sexually un functional. In female animals, the practice is referred to as spaying.

Reasons for castration:

- To prevent the bad smell especially in the Billy goats.
- To prevent undesirable males from breeding.
- To make the animal docile and easy to work.
- Castrated animals grow faster and produce quality meat.
- Castration increases the quality of wool in sheep as more nutrients are channeled to the development of the wool.
- It helps in the control of venereal diseases like contagious abortion.
- It controls in-breeding on the farm when males born on the farm are castrated.

Methods of Castration.

There are two main methods of castration namely:

- Open operation/ castration.
- Closed castration

1. Open castration:

This is where the scrotum is opened to remove the testicles. It can also be referred to as surgical operation.

This requires a sharp knife or blade to split the scrotum vertically up to the bottom for better bleeding.

Advantages of open castration

1. Ensures complete castration of the animal
2. It's a cheaper method of castration since it can be done using local implements like the knife.

Disadvantages

1. It requires a lot of skills to be carried out
2. There is a high risk of infection due to the wound created
3. It is slow to be carried out
4. There is risk of over bleeding more especially in mature bulls

Procedure of carrying out open castration:

1. Restrain the animal using rope and cast it down to reduce movements.
2. Wash your hands using clean water and Detol soap or wear clean gloves.
3. Wash the scrotum of the bull using disinfectant (Detol) and clean warm water.
4. Dry the scrotum using a clean hand towel.
5. Apply a localized anaesthesia a round the scrotum to reduce pain.
6. Pull and squeeze the scrotum to locate the testes.
7. Use a clean blade or knife and cut the scrotum vertically to expose and remove the testes, do the same on the other testes.
8. Pull the spermatic cords together with the blood vessels out and tie it using a clean string.
9. Cut the both the spermatic cord and blood vessels just below the knot to release the testis
10. Repeat the same procedure to remove the second testes
11. Seal off the wound to stop bleeding by using a hot iron.
12. Apply fly repellant on the wound to keep a way flies from laying eggs there
13. Apply antibiotic cream to stop the wound from becoming septic (rotting)
14. Release the animal and keep it in reach for easy supervision.

N.B: For some animals stitching can be done e.g. calves.

Apparatus used in Open castration

- A halter
- Clean water
- Surgical Blade / knife
- Insect repellant
- Anaesthesia
- Disinfectant (Dettol)
- An antibiotic

2. Closed castration;

This is a type of castration which is done without opening the scrotum. It can be done using the burdizzo/**burdizzo method** or using a rubber ring and elastrator/ **rubber ring method**

i) Burdizzo method.

A burdizzo is an instrument with handles which exerts pressure on closing its jaws on to the “neck” of the scrotum.

ii) Using a rubber ring & elastrator, a rubber ring is a thick round rubber which is stretched using an **elastrator** before being placed on the "neck" of the scrotum.

Advantages of closed castration

1. It's a fast method of castration
2. It requires less skills to operate.
3. No bleeding is experienced
4. Less risk of infection since no open wound is created

Disadvantages

1. Chances of a failed castration are common, since sperm dusts and blood vessels may heal function normally.
2. It is expensive to buy a Burdizzo, not all farmers can afford.
3. Castration using a rubber ring is very painful to the animal.

Procedure of Castration using a burdizzo

1. Restrain the animal using ropes and cast it down.
2. Pull the scrotum down wards to locate the spermatic cords, ducts and nerves
3. Open the jaws of the burdizzo by pressing the handles out-wards
4. Place the burdizzo at the "neck" of the scrotum
5. Press the handles of the burdizzo in-wards to lock the jaws and crush the spermatic cords, blood vessels and the nerves.
6. Open the jaws of the burdizzo and remove it from the crushed area
7. Release the animal (Oxen) after the operation
8. Keep the animal within reach for easy supervision

Procedure of Castration using a rubber ring:

Here a strong rubber band is stretched using an **elastrator** and fixed around the "neck" of the scrotum, when the animal is restrained. This cuts off blood supply to the scrotum and the testes which eventually degenerate and fall off after sometime. It's the most painful method of castration though very effective. The farmer doesn't expect any development of the scrotum for a life time.

3. IDENTIFICATION:

This is the practice of putting permanent marks in form Labels, letters, shapes, maps or numbers on undesirable parts of the animal, like the ears, jaws, thighs (rump) and the forehead.

Reasons for identification:

- Enables a farmer recognize his animal in case it's lost.
- To facilitate record keeping on the farm.
- To reduce cases of theft on the farm.

- It helps in feeding animals of different food requirements
- It reduces disputes between farmers.

Methods of identification:

The main methods of identification are:

- Branding using branding iron
- Ear tagging using tags
- Tattooing
- Ear notching using an ear notcher
- Using neck traps
- Nose ringing using nose rings
- Naming using names

A. BRANDING

This involves sealing numbers, letters, designs or a combination of these on the skin of the animal.

Methods of branding

These include:

- Hot iron branding
- Chemical branding
- Freeze branding

1. Hot Iron branding

This is done using a **branding iron** which is heated and stamped on the animal skin to leave marks for identification. Branding is done on the less valuable part of a hide like lower part of the thigh, jaw and hump

Procedure of hot iron branding

- Restrain the animal in a crush
- Heat the branding iron in fire or gas until red hot
- Stamp the hot iron on a less valuable part of the animal to burn the skin and leave marks
- Remove the iron from the skin after a few seconds
- Release the animal from the crush

2. Chemical branding

In this method, corrosive chemicals are applied on the skin causing leaving marks on the skin.

- Restrain the animal in a crush
- Clean the area to be banded
- Dip the branding equipment in the branding chemical
- Apply the chemical to the less valuable parts of the hide.
- Release the animal fro the crush

3. Freeze Branding

This involves applying liquid nitrogen to the skin which freezes the hair follicles so that they die and stop hair growth in that area.

A branding iron can be dipped in liquid nitrogen and then applied on the skin. The method is good since the skin / hide is not damaged and hence can be applied to any part of the animal.

B. EAR TAGS

They are made of light metals or strong plastics written on with different numbers, letters or designs.

The ear tags are of two types.

- piercing (self – piercing tags)
- non-piercing

The self fixing tags will be fixed on to the ear with force while a non – piercing ear tag, a hole must be made where it is fixed. An ear **tag applicator** can be used in stapling piercing ear tags on the ear

C. EAR NOTCHING

This involves cutting V – shaped notches on the edge of the ear using sharp scissors or pincers. This method is popular in pigs because of their soft skin. The number and location of notches on the ear can be used for identification

D. TATTOOING

A special ink is used to inflict marks on the skin of the animal more especially inside the ear. The hair must be removed from that place before tattooing.

E. NAMING

Animal are given specific names for identification depending on a number of things like origin, coat colour, e.t.c.

4. RESTRAINING

This is the hindering of movements of animals by physical force. It's done so as to perform operations on the animals like: dehorning, castration, de-worming, identification, vaccination and drenching with minimum disturbance. The amount of force applied during restraining depends on the temper, size and type of the animals. Cattle are not restrained in the same way as goats.

5. CASTING

This is a practice of putting animals down and it's done when animals are to be controlled for a long time during operations like castration, dehorning and identification.

6. GROOMING

This involves brushing off loose hair, dung, dirt and lice from the skin of an animal

Reasons for grooming

- To stimulate blood and lymph circulation in the body of the animal

- To remove loose hair, lice and other external parasites
- To facilitate mating in animals
- For cleanliness and good appearance for the animals
- For production of clean milk in lactating animals

7. FOOT TRIMMING

This involves removing overgrown parts of the foot which impairs movement of the animal. It controls lameness in animals

8. CULLING

This involves removing un-productive and sick animals from the herd for slaughtering / selling.

It controls disease spread and wastage of feeds on the farm

9. VACCINATION

This is done in order to control highly infectious diseases in livestock e.g. Swine fever, foot and mouth disease, New castle, rabies etc.

10. DRENCHING

This involves administering oral treatment as supposed to animals. Its done using a drenching gun/bottle to control internal parasites like liver flukes, round worms, tape worms, hook worms.

11. ROUNDING UP

This is done in beef animals and it involves bringing all animals on ranch in the centre of the kraal for the following reasons:

- Castrate and vaccinate animals
- Physical assessment of the animals
- To separate animals according to age, sex, type etc.
- To cull and market un productive animals
- To wean calves of at the right age
- To carry out pregnancy diagnosis

12. HOUSING

The main reasons why animals are housed are

- To protect animals from bad weather condition mostly young ones
- To provide animals with a good opportunity of being fed well
- To provide an area for special handling of the animals e.g. Crushes, dips, spray etc.
- To provide a conducive environment for production and temporary storage for milk (quality milk)
- To provide conducive working conditions for the farmer

Qualities of a good animal house

1. Provide an adequate floor space to avoid overcrowding
2. Should be water proof to avoid damp conditions that breed pathogens
3. Should have a concrete floor which is easy to clean
4. Should provide adequate light since it affects the productivity and behaviour of animals
5. Should have adequate ventilation to control respiratory infections
6. The floor surface should have a gentle slope to allow urine to drain off easily
7. Should be built in such a way that animals can easily see each other

LIVESTOCK BREEDING:

This is the mating of selected animals in a planned manner.

AIMS OF ANIMAL BREEDING

1. To maintain desirable qualities in animals like increased number of eggs produced in chicken, high number of off springs born per animal,
2. Produce animals with a high mothering ability i.e. low temperament and high milk production.
3. Produce highly fertile animals
4. Produce animals with a High growth rate
5. Produce animals that can give a lot product like milk and eggs
6. To come up with breeds that produce high quality meat, milk and egg
7. To produce breeds of animals that are resistant to parasites and diseases
8. Elimination of undesirable qualities in livestock
9. To produce animals with a high resistance to harsh environmental conditions
10. To produce animals that can provide products for a long period of time.

TERMS USED IN ANIMAL BREEDING

a) **Allele**: These are different forms of a gene at a particular locus e.g. Tt
b) **Back Cross**: This is a cross between an animal offspring and one of the parents
c) **A breed**: This is a large group of animals developed by the efforts of man having a common ancestry and possessing similar morphological, physiological and economic characteristics.
d) **Breeding**: This is a technique involved in mating selected animals because of their desirable characteristics.
e) **Chiasma**: This is a place of connection between two chromosomes seen during prophase I of meiosis.
f) **A clone:** This is the population of organisms reproduced by a sexual reproduction from a one individual.
g) **Crossing over**: This is the process of exchange of genetic information between two homologous chromosomes during meiosis.

h) **Diploid**: It's an individual cell having 2 complete sets of chromosomes.
i) **Epistasis:** This is where a gene masks the effect of another. The gene which masks is called **epistatic** gene. The masked gene is called a **hypostatic gene**.
j) **Dominant gene**: Its one which can express itself phenotypically in both homozygous and heterozygous states e.g. a gene for tallness (TT) in a garden pea.
k) **Inheritance**: It's a mechanism by which characteristics are passed on from parents to offsprings. If a character is 20% heritable. It means that the 20% is determined by the genes while the 80% depends on the environment.
l) **A hybrid**: These are the offsprings resulting from a cross between two parents of different breed or stock.
m) **Hybrid Vigor**: (heterosis) this is un usual growth and healthiness (better performance) of organisms resulting from the cross between two different parents or better performance of a hybrid beyond that of parents
n) **Inbreeding**: This is the mating of closely related animals
o) **Locus:** This is the physical position of the gene on a chromosome
p) **Linkage:** This is the tendency of genes located on the same chromosome to be inherited together in a successive generation
q) **Out Breeding:** This is the mating of unrelated animals and is sometimes called crossing
r) Pedigree: It's a chart showing the ancestry history of an individual
s) **Progeny:** These are off-springs resulting from a mating
t) **Recessive Gene:** A gene whose expression is only seen when in a homozygous state only.
u) **Heterozygous:** It's a situation where an organism has two different alleles e.g. Tt
v) **Homozygous:** It's a situation where an organism has two like alleles e.g. TT
w) **Sex chromosomes**: These are chromosomes that determine the sex of organisms e.g. X and Y chromosomes in animals.

SELECTION

This is a practice of allowing some animals to be parents of future generations while depriving others of that privilege.

Types of selection

There are mainly two types of selections i.e. **natural selection** and **artificial selection**

Natural Selection

This is one which always takes place through random mating and its influenced by natural forces e.g. the ability of one individual to survive and reproduce in a certain environment.

In such a selection only the fittest animals are able to survive hence survival of the fittest in the struggle for existence.

Artificial Selection

This is the type of selection controlled by man and doesn't allow random mating but mating is based on desired characteristics

Methods used in artificial selection

- Individual / mass selection
- Pedigree selection
- Collateral relatives selection
- Progeny tests
- Tandem selection
- Independent culling
- Selection index

Individual Selection

- This is done basing on the information about the animal's performance as well as the performance of its progeny. It measures the likelihood of a trait being passed onto the next generation.
- A comparison of animals based on their own individual performance is called the **performance test**. It's used for traits of high heritability such as growth rate, fertility, mothering ability and feed conversion efficiency.

Pedigree Selection

- Here animals are selected basing on the performance of their ancestors. This method is used for traits that can't be measured in life e.g. quality of beef.
- This method is not highly recommended because it can be easily manipulated by leaders and farm managers.

Collateral relatives Selection

This is selection done basing on performance records of close relatives like brothers, sisters, half brothers etc.

The transmission of traits (characteristics) with known importance between relatives can be measured using subtests.

The accuracy of sub-testing depends on;

- Family size
- Heritability of a character i.e. the ability of a trait to be transmitted from one generation to another
- Intra family genetic relationships

Progeny Tests

This is where selection is made basing on the performance of an animal's offspring (progeny)

It determines the value of an animal breed and performance reflected in the following

- Milk and butter fat production incase of dairy animals
- Carcass quality in beef animals
- Belly length in pigs

Advantages

- Weakly inherited traits are easily noted and decisions made
- Its easy to know practically the productive qualities for both the bull and the cow
- It's more suitable for traits which are exposed after slaughter such as the carcass quality.

Disadvantages

- It's a very expensive method of selection because it involves a lot of consideration before reaching the final judgment
- It needs a lot of time hence its time wasting

Tandem selection

This where a desired trait is selected among many and improved before going for another

Independent culling

The breeder lays down a minimum standard for several traits and any animal that does not measure up to standard is culled

Selection index

Here, numerical values are given to potential parents basing on their characters and one with the highest value is selected

Factors considered in selecting animals for breeding

1. Adaptability of the animal to environmental conditions
2. Availability of the breed with in the environment
3. Availability of market for animal products for the animal being bred
4. Animal temperament should be low for easy handling
5. Animal resistance to pests and diseases should be high
6. Animal body conformity should confirm the breed and type
7. History of success of the breed in the environment
8. Feed conversion ratio of the breed i.e. should have a high ability of converting feeds into products like milk, meat and eggs
9. Growth rate of the breed

10. Availability of quality feeds for the animals
11. Fertility of the animal being considered
12. Productivity of the animal in terms of milk, meat and eggs

BREEDING METHODS

This refers to those methods which deal with how the breeds that have been selected as parents for the next generation are mated.

Breeding methods are classified into two broad groups namely:

- **Close breeding**
- **Out breeding/ cross breeding**

Close Breeding

This is the mating of related animals e.g. a daughter and a father, a son and a mother, brother and a sister, grandparents and grand offspring.

Close breeding involves **inbreeding** and **line breeding**

Inbreeding

This is that mating of closely related animals like brother and sister, son and mother, e.t.c.

Advantages of in breeding

- It helps to maintain a high relationship with the desirable ancestor.
- It increases the degree of uniformity in the herd
- The less desirable recessive genes are easily brought to light and therefore culled.
- The good qualities of a particular breed can be easily maintained

Disadvantages

- It requires a lot of skill in making planned mating and rigid selection
- It leads to a reduction in survival chances of off-springs
- Leads to a reduction in the fertility of animals
- The off-springs got are usually of poor size

Line Breeding

- This can be defined as the mating of animals of the same breed or distant relatives e.g. cousin, grandson and grandmother
- It's actually practiced in order to conserve the good traits of a certain outstanding sire or dam.

Out breeding /out crossing

- This is the mating of unrelated animals. Sometimes such animals can be of the same breed but show no close relationship in the first four generations
- Out breeding results in the production of offsprings that are of better performance than the parents i.e. hybrid vigor.
- Crossing can be done between breeds, species and lines. Examples of crosses between species are;

Male **lion** and female **tiger** results in a **Liger**
Male **donkey** and female **Zebra** results in an **Asbra**
Male **Horse** and female **Zebra** results in a **Zebroid**
Male **horse** and female **Donkey** results in a **Mule**
Bull and female **buffalo** results in a **Beefalo**

Grading Up

This is a system whereby pure exotic sires are mate with the local animals to improve the characteristics of local animals e.g.

	Local female	x	100% pure sire/ male
F_1	50% pure female	x	100% pure sire/ male
F_2	75% pure female	x	100% pure sire/ male
F_3	87% pure female	x	100% pure sire/ male
F_4	93.7% pure female	x	100% pure male

BREEDING EFFICIENCY

This is the ability with which the herd is able to reproduce and multiply. It covers the entire period of breeding i.e. mating, conception, gestation and calving.

It measures the following;

1. **Calving interval:** This is the period between calving. Normally it is about 12 -13 months. In order to get a good calving interval, a rest period of 60 days should be given for the animal.

2. **Age of heifer at first calving** which should be 24 months. A higher age indicates a low breeding efficiency

3. **Services per conception**. The ideal ratio should be 1.6-1.8 and is measured by $\frac{\text{Number of services}}{\text{Number of animals that conceive in a herd}}$
4. **Percentage of cows that calve within a year**. A high percentage indicates a high breeding efficiency

5. **Number of days a cow is pregnant in a year**. The more the days, the higher the breeding efficiency

6. **The percentage of non-returns**. Non-returns arise when the service is done and pregnancy does not occur. A low percentage of non-returns indicates a high breeding efficiency and vice versa

Maintaining a high breeding efficiency

1. **Good feeding**: Breeding animals should be fed well but excessive fattening should be avoided as it may reduce the fertility.
2. **Observing the rest period**: Animals should be given a rest period of about 60 days to allow the uterus to return to normal
3. **Insemination at the right time**: Incase of A.I, the cow should be inseminated towards the middle and late part of heat period as ovulation occurs 14 hours after the beginning of oestrus
4. **Observation of animals on heat**: This should be done as early as possible more especially where A.I is being used to avoid the animal missing service.
5. **Veterinary Attention:** Animals that fail to conceive should be identified and examined to find out the causes and treated if possible.
6. **Pregnancy diagnosis:** Animals should be diagnosed to find out whether they have conceived or not so that appropriate measures can be taken in time.
7. **Keep accurate breeding** records for the herd to be used as reference were necessary
8. **Use teaser bulls** for early detection of heat in farm animals for early service
9. Maintain a good ratio of bulls to females to avoid over working the bulls which lowers fertility
10. Use correct **techniques of artificial insemination** to ensure successful fertilization hence high breeding efficiency
11. Females with abnormal discharges should examined and treated early enough
12. Know a complete breeding history of the animals before buying it into the farm

Mating animals

Animals can be mated using two main methods i.e. **natural service** and **artificial insemination**

NATURAL SERVICE

This is where male mates with the female directly. It is the most common method of service in Uganda

Advantages of natural service

1. Less costly since collection and processing of semen is not involved
2. Best methods serving animals with silent heat
3. Conception rate is higher than artificial insemination
4. Its a quick method of service
5. Does not require special skills and training

Disadvantages

1. Reproductive diseases can be easily spread
2. It's difficult to practice controlled breeding under this method
3. Heavy bulls can easily injure weak females
4. Wastes semen on one female that would otherwise serve 100 females
5. Breeding records are difficult to keep

ARTIFICIAL INSEMINATION

- It's a method of breeding in which semen is obtained from the male and introduced into the female reproductive tract by means of an instrument without direct contract between the males.

Advantages

- It's easier and cheaper to transport semen from distant places than transporting a bull
- Semen from good males may be stored for use in future years even after the death of such animals
- This enables controlled seasonal and planned breeding on farms
- It's easy to keep accurate breeding records since the time of service is always known
- Its easy to control venereal diseases e.g. contagious abortion and trichomoniasis in a herd since semen used is first examined
- Poor breeds or bulls can be easily eliminated from the breeding programme giving room for better sires
- Semen from lame bulls and those that are dead but of good quality can be easily used in the breeding programme
- Injury to small and weak females by heavy bulls can be controlled using artificial insemination.
- It reduces the cost and the risk of keeping a bull on the farm since bulls are usually aggressive.
- Semen from good sires can be easily made available to farmers in rural areas through artificial insemination.
- Artificial insemination is economical since one ejaculation can serve over 100 cows after dilution.

PROBLEMS/LIMITATIONS OF ARTIFICIAL INSEMINATION (A.I)

- Silent heat; Some female animals do not show signs of heat hence it's very difficult to carry out A.I on such animals.
- The method of communal grazing in Uganda does not easily allow A.I since poor bulls from different herds can mount animals.
- There is a danger of disease outbreak more especially if contaminated semen is used.

- Special skills are required to carry out A.I which may be lacking among the farmers
- Semen requires special equipment and conditions for storage which may not be easily available to the rural farmers.
- Poor roads in rural areas make the transportation of semen to such places difficult and expansive.

Methods of carrying out AI

There are two main methods of AI i.e. **Recto-vaginal** method and **Speculum** method

Recto-vaginal method

This is where the rectum and vaginal are manipulated in order to have successful insemination. The hand is pushed in the rectum to remove dung and locate the cervix at the end of the vagina

Procedure

1. Restrain the animal in a crush to restrict its movement during the operation
2. Wash your hands with clean water and soap to reduce infection
3. Put on clean gloves
4. Thaw the semen in a basin of water at room temperature to reactivate the sperms
5. Sterilize all the equipment to be used
6. Insert the semen straw in the inseminating syringe
7. Lift the animal's tail and insert one of the hands into the rectum to remove dung
8. Clean the anus and vulva using clean water and soap
9. Insert the hand in the rectum to locate the cervix in the reproductive system
10. Insert the inseminating syringe through the vagina and gently direct it to the cervix
11. Release the semen to the cervix
12. Massage the cervix after releasing semen so that it can be sucked into the uterus
13. Gently remove the inseminating syringe from the vagina and the hand from the rectum
14. Release the animal from the crush and monitor it for 21 days to ensure that it has conceived

Speculum method

This is where special equipment called **a speculum** is used in locating the cervix by inserting it in the vagina.

Procedure

1. Restrain the animal on heat in a crush
2. Wash your hands using clean water and soap and dry it with a hand towel
3. Sterilize all the equipment to be used in inseminating
4. Thaw the semen in a basin of water at room temperature
5. Insert the semen straw in the inseminating syringe
6. Wash the vulva with clean water and soap
7. Wear clean gloves
8. Insert the speculum into the vagina to locate the cervix
9. Insert the inseminating syringe into the speculum and release the semen
10. Gently remove the inseminating syringe from the speculum
11. Remove the speculum gently from the vagina
12. Release the animal from the crush

REPRODUCTION IN FARM ANIMALS

- This is a process that determines the existence of any animal species and the profitability of that animal. Reproduction is responsible for the number of organisms / animals which will lead to increased animal products, employment and diversification of the economy.

Hormonal control of oestrus

- Oestrus is a period of high sexual desire in female farm animals. It is characterized by physiological and behavioural changes.

The female oestrus cycle (Heat period)

- The anterior pituitary gland secrets a hormone called follicle stimulating hormone (**F.S.H**.) which stimulates the growth of Graafian follicles in the ovary.
- It also stimulates the ovary to secrete a female sex hormone – **oestrogen**.
- **Oestrogen** causes the signs of heat in females and also stimulates the anterior pituitary glands to produce another hormone called **Lutenising hormone (LH).**

  Oestrogen makes the female animal more receptive to the male and increases sex urge in females.
- **Lutenising hormone** causes the rapture of mature follicles to release the ova in the process of ovulation.
- After ovulation, lutenising hormone stimulates the development of the yellow body (corpus luteum) from the remains of the follicles.
- The corpus luteum produces a hormone known as **progesterone** which stimulates the growth of the endometrium in preparation for implantation.

- Progesterone also inhibits the release of follicle stimulating hormone and lutenising hormone from the anterior pituitary gland.
- After a successive fertilization, the progesterone stimulates the growth and improves blood supply to the endomentrium for successful implantation.
- After implantation, the **corpus luteum** degenerates and the placenta becomes the new source of **progesterone**.
- Relaxin causes the cervix muscles to relax and allow the foetus to move out during parturition
- Oxytocin
- Prolactin

Multiple Ovulation and Embryo Transfer (MOET)

This is the ability to make female animal simultaneously produce several ova which are fertilized to form embryos.

Objectives of MOET

1. Increases the number of offsprings in the life time of a female farm animal t
2. Makes cows with good traits produce more offspring for breeding beyond they natural capacity
3. Can be used in preserving endangered species since multiplication of offspring is high
4. It is easier to transport embryos than a live animal
5. Enables offspring to acquire better immunity from surrogate mothers
6. Weak and sick females can participate in the breeding programme

Limitations

1. It is very expensive to carry out
2. It requires a lot of skill to be carried out
3. Success rate is very low

Important reproductive events in farm animals

Animal	Age at puberty in months	Length of heat in hours	Length of heat cycle in days	On set of heat after giving birth In days	Length of pregnancy in days
Cow	9-18	18-24	21	30-60	280
Ewe	7-8	24-48	21	17	147
Sow	5-6	48-72	21	7-56	110-118
Nanny / female goat	7-10	48-72	21	Next season	150
Dog	7-9	18-25 days	6 months	6 months	63
Horse	12-36	2-12	18-28	5-15	335

		days			
Rabbit	3-7				31
Buffalo	10-20	2-24	11-30	40-60	320
Camel	24-36	3-6 days	20-28	20	390

SIGNS OF HEAT IN CATTLE

- The vulva swells and becomes red in colour
- The animal urinates frequently
- An animal on heat mounts other animals and allows others also to mount on it.
- There is a reduction in milk yield for lactating vows
- The animal becomes restless i.e. moves up and down in such for the male
- It sniffs the vagina of another cow
- Licking and rubbing of each other has also been noted amongst animals on heat.
- There is less feeding as more time is spent in walking
- There is a slight rise in the body temperature
- There is mucus d discharge from the vagina
- The animal will stand still to be mounted by a bull (standing heat)

Note: Production of bloody mucus from the vagina means that heat has been missed.

SIGNS OF HEAT IN SHEEP

- The female pays close attention to the male
- The female wags its tail more vigorously
- It stands still when mounted by the male but its hard for it to mount others.

Signs of heat in pigs

- There is an intense search for the male by the female
- The female pays little attention to food
- The vulva becomes congested and swollen
- The sow emits short grunts
- It stands still when pressure is applied to the back
- There is reddening of the vulva more especially in the white breeds
- The sow can mount others and also allows others to do so.

Infertility in farm animals

This is a temporary failure of an animal to reproduce which can be corrected
Sterility is a permanent and irreversible failure of an animal to reproduce

Causes of infertility in cattle

- **Inheritance**: some families of animals inherit low fertility from their parents

- **Twinning in cattle**: Although its rare in cattle, but when it happens, heifers born co-twin with males (free martins) can be sterile.
- **White heifer's disease:** This is infertility which is caused when the hymen is too strong and thus preventing natural mating or artificial service of the cow.
- **Cryptochidism**: This is when the male animals are born with both testes retained in the abdominal cavity making it un able to produce sperms.
- **Retained corpus luteum:** this prevents the development of the eggs in the ovary by continuous production of progesterone (maintains pregnancy)
- **Cystic ovaries:** This is when follicles fail to rapture in order to release the ova causing a condition called **Nymphomania** (excessive desire for sex) and the cow is set on prolonged heat.
- **Nutritional deficiency:** Lack of vitamin A which is responsible for the formation and maintenance of membranes in the reproductive system lowers the fertility of cattle
- **Excessive conditioning (fattening) animals:** Heavy fat deposits on the ovary affects its functioning and cause low fertility / infertility.
- **Management**: Mating the animal too soon after calving, too early or late after onset of heat and failure to recognize heat signs will lead to infertility.
- Venereal diseases like brucellosis and Trichomoniasis can also cause low fertility in farm animals.
- Un favourable conditions in the reproductive tract of a female can cause infertility
- Use of defective sperms during service lowers animal fertility

SIGNS OF PREGANANCY

- Failure of the animals to have heat after 21 days.
- Increase in the size of the belly more especially on the right-hand side.
- A higher concentration of progesterone in milk and plasma 21 – 24 days after conception
- The cervix opening is sealed and closed by a gelatinous and tough secretion
- Udder tissues develop and enlarge especially in heifers at the 6th month of pregnancy
- At the later stage, the signs of life in the foetus can be felt after applying slight pressure on the right-hand side of the belly
- Laboratory analysis of blood shows a higher level of progesterone in it

Care for a pregnant cow

1. Provide clean water to the animal without any restriction
2. Carry out pregnancy diagnosis two month after service to confirm pregnancy
3. Dry off the animal at the 7th month of pregnancy to prepare it for the next lactation
4. After drying carry out dry cow therapy to control mastitis

5. Regularly deworm the animal to control internal parasites that may affect the unborn calf
6. Provide adequate feeds through out the period to cater for high nutrient demands
7. Steam up in the last 2 months of pregnancy to prepare the animal for lactation
8. Regularly control external parasites by spraying Atleast twice a week
9. Vaccinate the animal against killer diseases so as to protect the un born calf
10. Isolate the animal in the last 2 months from the general herd in put it in a nurse paddock
11. Provide a clean dry calving pen for the cow
12. During calving, assist the animal with difficulties
13. Milk the animal a little to reduce the udder pressure
14. If the after birth is retained, call in a vet for help

Steaming Up

This is the practice of giving extra nutritious feed to a pregnant cow two month prior to calving.

Importance of steaming up

1. It prevents nutritional disorders associated with milk secretion like milk fever
2. It allows the heifer to get used to the milking place when steamed in a milking parlour.
3. Replaces the nutrients that have been used in the development of the foetus
4. It prepares the cow/ heifer physiologically for the next lactation period.
5. Allows the animal to put on weight in preparation for calving
6. Makes a heifer get used to feeding on concentrates
7. Stimulates the development of mammary glands for milk production
8. Encourages the production of high quality colostrums for the calf at birth
9. For proper growth of the foetus

Signs of calving

1. The cow / heifer stays away from the general herd and lies down rather than standing.
2. The udder becomes extended as well as the teats
3. The cow becomes increasingly uneasy
4. Loss of appetite
5. The vulva becomes flabby (becomes soft and loose)
6. There is frequent urination
7. Repeated arching of the back and raising of the tail

Care of the cow at calving

1. The animal should be taken to the calving paddock or stall
2. The place where the cow is to calve should be clean and free from sharp objects
3. The animal should be let to deliver by itself for at least 1 hour
4. In case of failure, the veterinary officer should be called in for help.
5. Remove the after birth as soon as possible

Care after calving

1. The calf should be left with the mother so that it can clean it by licking.
2. Normally, the calf removes the mucus membrane from the nostrils by sneezing
3. In case the calf fails to breath, artificial respiration should be initiated by:
   - mouth to mouth respiration
   - handling the calf with the hind legs and lifting it up then releasing it gently
   - tickling the nostrils with a piece of straw to initiate sneezing
4. Give the cow warm water to drink so as to assist in the digestive system
5. Disinfect the naval cord of the calf with iodine to reduce infections
6. Milk the cow a little to release the pressure in the udder
7. Allow the calf to stay with the mother for 2 – 3 days to ensure that it takes colostrum.

Management of calves from birth to weaning

1. Clean the calf by removing the mucus membranes from the calf in case the mother fails
2. Disinfect the umbilical cord using dettol and tie it to stop tetanus infection
3. Incase the calf fails to breath normally, artificial respiration should be initiated
4. Leave the calf with the mother to ensure that it takes colostrum
5. Incase of artificial rearing, the calf should be trained to drink from the bucket with in two days after birth
6. Feed the calf on clean milk Atleast twice a day
7. Provide plenty of clean drinking water at all times of the day
8. Provide roughage to the calf at the age of about 2 weeks to facilitate rumen development
9. Towards weaning, introduce milk replacers to save milk for the market
10. Carry out identification of the calf Atleast 2 weeks after birth
11. Male calves that are not going to participate in the breeding programme should be castrated in the 4^{th} week from birth
12. From extra teats fro female calve at the age of 2 weeks

13. Calves should be dehorned using the hot iron method in the second week
14. Deworm calves regularly to control internal worms that affect growth
15. Vaccinate calves against killer diseases to reduce mortality
16. Clean the pen regularly by removing dirty litter so as to reduce infections
17. Wean the calves at about 2 months after attaining the right weight

Major causes of calf mortality

1. Calf scours characterized by diarrhea with a foul smell
2. Calf pneumonia; this caused by poor housing conditions
3. Navel infection; this caused by bacterial attack of the navel creating septic conditions
4. Internal worm infections resulting into stunted growth and diarrhea
5. Calf coccidiosis characterized by feaces with foul smell. It is caused by bacteria
6. East Coast Fever which is transmitted by ticks and caused by protozoa. It is the leading cause of death in exotic calves. It is characterized by swollen lymph nodes of the parotid and diarrhea

Feeding calves

After calving, the calf should not be removed from the mother for the first 2 – 3 days in order to ensure colostrum intake.

Colostrum feeding:

Colostrum; This is the milk produced by a cow for the first 3 – 4 days after calving. It is different from normal milk in the following ways:

i) It contains very high antibody content about 5 times more than normal milk.
ii) It has a high protein and vitamin content

Reasons for giving the calf colostrum

1. Contains antibodies which help the calf to fight disease
2. Removes sticky materials from the alimentary canal of the calf
3. It contains a lot of nutrients which are needed highly by the calf.

Methods of feeding / raring the calves

1. Natural rearing/Suckling: This includes single suckling (natural suckling), restricted suckling and foster mothering (multiple suckling)
2. Artificial rearing / bucket feeding

A. Single Suckling

This is where a calf is left to suckle from the mother without any restriction until it is weaned at about 4 – 6 months. This method is restricted to beef production and places where there is little market for milk.

Advantages of single suckling

1. It is the simplest and best way of producing large healthy calves
2. It is a suitable method for the beef farmers who have a little interest in milk but more in the beef of the animals.
3. It is Labour saving as compared to the artificial rearing
4. Diseases due to unhygienic conditions e.g. Calf scours observed in bucket feeding are rare in this system.
5. Calves get milk at the normal body temperature which enhances proper digestion
6. This is the most suitable method of raising calves in places with low market for milk.
7. There is low mortality rate under this method of raising calves.

Disadvantages of single suckling

1. It is very difficult to keep feeding records in this system since the amount of milk taken by the calf is not known.
2. Injury to the teats is common as the calves suckle

B. Restricted suckling

The calves are allowed to suckle at certain periods of the day e.g. after the morning and evening /afternoon milking. Supplementary feeds can be easily introduced.

Advantages

1. Well grown calves can be realized with proper management
2. There is a tendency of getting a high milk yield from the dam as it is milked in the presence of the calf.
3. There is low mortality rate since calve get clean milk at the right temperatures
4. Less cases of mastitis are noted under this method
5. It saves both Labour and time.
6. Provision of supplementary feeds to calves would greatly improve their growth.

C. FOSTER MOTHERING

In this method, a substitute mother is used in providing milk to the calves. The calf is first allowed colostrum for three days then allocated to the foster mother.

Advantages

1. The dam will give more milk when the calves are left to suckle it.
2. The method gives good calves as compared with bucket feeding.
3. The method uses less Labour since supervision is little
4. The calves are able to get the milk at the normal body temperatures
5. There are fewer cases of calf scours
7. Case of mastitis in cows is rare
8. Milk from other dams can be saved for the market

Disadvantages

1. In case of an infectious disease, a farmer may lose a good number of calves.
2. Weak calves are denied a chance of suckling at most times by the strong aggressive calves.
3. Injury to teats caused by the calves is more common
4. It is very difficult to keep feeding records in this system.

ARTIFICIAL REARING (BUCKET FEEDING)

In this method, calves are removed from the dams three days after birth and reared by feeding them on milk or milk substitutes from a bucket.

Training the calf to drink from the bucket

1. The calf should be removed from the dam three days after birth to ensure colostrum intake.
2. Immediately After milking, the bucket with the milk should be presented to the calf for training.
3. Wash your hands with clean water and soap and dry iy using a clean hand towel
4. The trainer should dip the index and middle fingers in the milk and later place it in the calf's mouth to suckle.
5. The calf suckles the fingers as the trainer lowers the hand in the bucket containing milk.
6. As the mouth of the calf approaches the milk in the bucket containing milk, the fingers are removed slowly to allow the calf to drink milk.
7. The calf begins slowly to drink the milk and later learns
8. The calf should not be allowed to drink in large quantities at ago as the milk can choke it or enter the undeveloped rumen where it would ferment causing digestive disturbances.
9. Training can be repeated until the animal learns

Advantages of bucket feeding

1. It is easy to keep feeding records that can be referred to in any case since the amount of milk taken is known
2. Calves can be easily rationed according to their body needs
3. The farmer can introduce milk substitutes easily and therefore save milk for market.
4. The method permits early weaning which can save milk
5. The dam will give milk even when the calf dies
6. It encourages better management of the herd since the lactating cows are fed according to their production.

Disadvantages

1. The mortality rate in this system is high since in most cases calves are given less or dirty milk.
2. Calves are more prone to diseases due to unhygienic conditions associated with feeding the calves
3. The method requires more labour and attention which are expensive to the farmer.
4. Incase of an infectious disease, the farmer may lose a good number of calves.

DIARY CATTLE

These are cattle reared specifically for milk production.

Examples of exotic dairy breeds

Friesian, Ayrshire, Jersey, Guernsey and Kerry

Characteristics of a good dairy breed

a) Should be a high milk yielder
b) Should be resistant to pests and diseases
c) Should have a high fertility
d) Should be docile hence easy to be milked
e) Should have a large udder
f) Should be able calve easily
g) Should have a big milk vein
h) Should be able calve regularly for along time
i) Should have a well suspended udder with four functional teats
j) Should have a long lactation which ensures continuous milk production
k) Should have strong hind legs for supporting a big udder

Factors to consider before establishing a dairy herd

1. **Capital**

   This is needed in the construction of farm structures, purchase of land and the animals.

2. **Land**

There should be enough land to accommodate farm buildings and paddocks where animals can graze from

3. **Labour**
   Both skilled and unskilled Labour is required for performing specialized work and manual Labour respectively.
4. **Reliable source of water:** Water is needed by the animals for drinking and also in other farm operations like cleaning and mixing of drugs.
5. There should be a ready market for milk and milk products which is easily accessible to reduce the costs incurred in looking for market.
6. **Pastures**: The place in consideration should have good pastures since the production of the animals is greatly affected by the quality of what they eat.
7. There must be reliable transport so that the farmer can easily move farm products to the market and bring back inputs.
8. The breed selected should fit the market demand and the Climatical conditions of the place in consideration.
9. Security is a very important factor for any business since insecurity results into loss of property and life
10. Government policy in place should be encouraging dairy farming through the provision of good breeds of cattle
11. Climate in the area should be good for dairy farming

Importance of Dairy farming

a) Provides income to the farmer all year round since animals produce at any given period of the year
b) They can provide dung used for making farm yard manure
c) Can provide quality meat at the end of milk cycle after fattening
d) Provide food to the farmer in form of milk
e) Provide market for industrial products like meat
f) They are good converters of inedible pastures into milk

Strength of the dairy industry in Uganda

a) High demand for dairy products in Uganda
b) Integrated farming practices can accommodate dairying
c) Suitable climate in most areas of Uganda that favours animal production
d) Availability of quality fresh pastures through out the year
e) Improved infrastructure that make transportation of milk to the market easy
f) Increased research and development in dairy farming
g) Improved extension services in dairy farming
h) Historical factors like a long history of cattle keeping among tribes in Uganda.

Introducing exotic dairy cattle in an area

a) Fence off the whole grazing area to keep out intruders and pests
b) Partition the grazing land into paddocks for easy pasture management
c) Remove all weeds and injurious objects from the grazing land
d) Install water points in all paddocks for the animals
e) Introduce bait animals to the paddock to control ticks 3-6 months before bringing in the exotic animals
f) Spay or dip the bait animals regularly over the whole period
g) Remove the bait animals after a specified period and introduce the exotic animals
h) Regularly spray or dip the exotic animals to control external parasites

MANAGEMENT OF DAIRY CATTLE

1. **Regularity of care:** The operations done on these animals should be performed regularly without abrupt interruptions as those may affect the production of animals.
2. **Kindness to animals**: Rough handling of animals like beating reduces the productivity and can even cause injuries that may be expensive to treat.
3. **Exercise:** Animals need light exercise for good health but long distances of movement should be avoided as these require a lot of energy lowering animal production.
4. **Grooming:** Keeping hind quarters of animals off dung, loose hair and any dirt by brushing and dipping leads to production of high quality milk.
5. **Hoof trimming:** Overgrown hoofs should b trimmed to avoid difficulty in movement and lameness
6. **Dehorning:** Apart from introducing uniformity in the herd, handling of dehorned animals is easy and less risky
7. **Identification:** For record purposes, dairy animals should be identified by ear tagging notching, branding and tattooing.
8. Provision of adequate water; Animals need enough water since the biggest percentage of their body is water. Excessive loss of water from the body reduces milk produced.
9. **Breeding:** A farmer should aim at breeding of his herd to increase animal number and productivity by incorporating good breeds in the breeding programme.
10. **Proper feeding**; dairy animals should be given enough and highly nutritious feeds to improve and maintain a high level of production

MILK SCIENCE

This is the way how milk is harvested from a cow.

Structure of the udder

Milk secretion

1. Milk is secreted by the secretory cells called **alveoli secretory cells** in the udder under the influence of **prolactin** hormone fro the anterior pituitary gland
2. Milk is made from the nutrients eaten by the animal like blood sugar, amino acids and fatty acids
3. Vitamins and minerals can be added to milk from blood
4. The manufactured milk can be stored in cavities of the alveoli and small ducts

Milk composition

Component	**Percentage**
Fat (Butter fat)	3.7
Sugar (Lactose)	4.8
Protein (Casein)	3.2
Mineral	0.7
Water	86.6
Solids	1.0

MILK-LET DOWN

This is down flow of milk from the udder to the lowest part of the teat or it is process by which milk is removed from the alveoli and small duct systems to the lower part of the udder i.e. gland cistern and teat canal.

Process of milk let down

1. When the udder is stimulated, by **washing with warm water** or **suckling** by the calf, a message is sent to the **anterior** part of the brain through the **spinal cord**.

2. A hormone called **oxytocin** is released in the blood stream from the anterior pituitary gland.
3. When the hormone reaches the udder, it causes contraction of muscles surrounding the **alveoli**
4. The squeezing action forces the milk into the **gland** and **teat cisterns**
5. The action of suckling / milking will bring the milk outside.

Ways of stimulating milk let down

1. Taking the cow to the milking parlour
2. Massaging the udder or washing it with warm water
3. Noise or rattling of milk buckets
4. Feeding of the on concentrates cow in the milking parlour
5. Approach of milking time
6. Presence of the calf at the milking place

Rules of good milking

1. Avoid exciting the animal before and during milking
2. Prepare and assemble the milking equipment before hand
3. Milking tie should never be interrupted
4. Milk at the same time every day
5. Prepare the cow for milk letdown by washing the udder with warm water
6. Use a strip cup to test for mastitis
7. Begin milking soon after preparing the cow to utilize short period of milk letdown

Milk-hold up

This is the opposite of milk let down where the cow holds up milk due to the production of adrenaline. Adrenaline limits blood supply to the udder therefore preventing oxytocin from reaching the muscles surrounding the alveoli. Adrenaline is produced when:

1. Presence of strangers around the milking parlour like dogs and cats
2. Rough handling of the animal by beating
3. Too much noise at the milking parlour
4. Improper dressing and change of the milking person
5. Pain during the milking process caused by mastitis or injury to the teats.

Milking Procedure

1. Assemble all milking equipments like buckets, cans and milking strainer in the parlour to avoid time wastage.
2. The cow to be milked should be restrained while in the parlour by tying the hind legs with a milking rope.
4. Wash the udder with warm water and soap and dry it using a hand towel.
5. Milking salve should be smeared on the teats to reduce friction and injury to teats

6. A strip cup should be used to test milk from each teat for mastitis
7. Cows suspected of mastitis should be milked last and the milk poured away
8. Follow the right milking technique of applying pressure to the outside of the teat while holding the it between the index finger and thumb.
9. Weigh and record milk from each cow immediately after milking
10. Milk should be filtered using a milking strainer before being put in the can for cooling to remove all dirt and any foreign material like hair.
11. All the milking equipment should be washed after milking and hanged upside down in the sun to dry.

    Note: The milking should be done in seven minutes to utilize the time for milk let down.

GUIDELINES TO CLEAN MILK PRODUCTION

Milk is said to be clean if:

1. It is free from dirt and any other visible matter
2. Has normal composition
3. Has desirable flavour
4. Free from harmful bacteria

In order to produce clean milk, the following points are important:

1. Clean, healthy cows must be maintained free of brucellosis and tuberculosis
2. Regular grooming and washing of animal is important for removal; of dirt and l loose hair that can contaminate milk.
3. All the equipments used during milking must be kept sterile by washing and drying.
4. The milking parlour should be kept spotlessly clean to reduce contamination of milk by microbes
5. Personnel handling milk should be clean by having clean clothes, short hair and finger nails
6. Milk should always be covered when in containers to stop foreign material from entering it.
7. The person milking should not be suffering from any contagious disease e.g. Tuberculosis.
8. Cows suffering from mastitis should be milked last and the milk poured away to reduce the spread f the disease.
9. Regular tests for tuberculosis in the herd should be carried out regularly and animals found with tuberculosis should be cull
10. Before milking, the milker should wash his hands thoroughly and dry it with a hand towel to reduce contamination of the milk with dirt.

11. The milking parlour should be far away from poultry houses, piggeries, manure pits and latrines which may pollute the air and provide a breeding ground for flies.
12. The milking parlour should be built on a high ground to permit good drainage
13. Wild plants which have an odour that can taint milk should be removed from the milking place.
14. Milk should be cooled from the normal temperature of 37^{o}C to 4^{o}C to reduce bacteria multiplication.
15. Proper milking techniques should be followed to reduce injury to teats and contamination of the milk.

FACTOR AFFECTING THE QUALITY (COMPOSITION) AND QUALITY (YIELD) OF MILK

1. **Breed**

Friesians produce large amounts of milk but of low butter fat while the indigenous produce less milk of high butter fat.

2. **Age**

Older cows produce more milk than the young. However, the butterfat of the milk produced by the older cows is lower than that of the young cows.

3. **Period of lactation**

Milk yield increases until the 7th week then it starts declining up to drying off.

4. **Animal Health**

Sick animals give less milk which may also contain antibodies and drugs more especially after treatment.

5. **Animal Temperament**

Quiet animals are the best milkers while nervous cows which kick about give less milk.

6. **Water Supply**

Water is needed for the health of the cow and also in the manufacture of milk since it is 87% water. Provision of enough water increases milk yield

7. **Food eaten**

Animals fed on concentrates will produce more milk which is of better quality than those feed on the ration full of roughages.

8. **Season of the year**

During the rainy season cows produce milk with high butter fat content. The quantity of milk is also high due to the abundant pastures and water.

9. **Heat Period**

Oestrus causes a slight decline in milk production which may be due to the reduced feed intake. The butterfat content of the milk can also fluctuate by 1% above / below normal.

10. **Temperature**

High temperatures reduce milk yield due to the increased evaporation of water of water from the animal's body.

11. **Management**

Proper feeding of animal and better handling during milking will increase the quality and quantity of milk produced. Rough handling leads to the increase of adrenalin and hence milk hold up.

12. **Milking Interval**

The greater the number of milking times, the higher the amount of milk produced. However, morning milking produces milk with higher butter fat content.

METHODS OF MILKING

There two main methods of milking

1. hand milking
2. machine milking

Hand milking

Advantages

1. Spread of mastitis is limited as compared to machine milking where mastitis is easily spread through the teat cups.
2. Hand milking has a low initial capital and therefore peasants can afford it.
3. It can not be limited by power therefore more applicable to rural areas with no power.
4. Injury to teats is not common as witnessed in machine milking due to faulty machines.

Disadvantages

1. It is very slow in operation and therefore cannot cope with large herds.
2. Efficiency declines with increase in the time worked
3. It is difficult to produces clean milk under this method
4. It is difficult to have complete milking hence a farmer stands to lose.
5. It increases Labour costs as more people are employed.

MACHINE MILKING

Advantages of machine milking

1. It produces clean milk more easily than hand milking
2. Complete milking is easily achieved
3. There is reduction of Labour cost since one person can handle more than 1000 cows in a short time.
4. It is faster in its operation hence saving time for animals to graze.
5. Can easily cope up with a large piece of work without getting tired.

Disadvantages

1. Needs skilled Labour to operate the machine which may be difficult to attain.
2. Its limited by power supply and can not work in places with no power.
3. Faulty machines can cause injury to teats

4. Diseases like mastitis are easily spread since the animals share the same teat cups
5. The initial cost of buying and installing the machine is high for most of the farmers in Uganda
6. It is only economical on farms with very large numbers of lactating animals.

DISEASES ASSOCIATED WITH LACTATING COWS

1. Mastitis

This is un inflammation of the udder caused by a number of bacteria and the most common are: - Streptococci and staphylococci

TYPES OF MASTITIS

a) **Acute Mastitis:**
This is sudden in occurrence, marked with changes in the udder.

b) **Chronic Mastitis:**
This is slow in onset without obvious signs

Spread of Mastitis:

Can be spread through: -

- The milkers' hands,
- Teat cups of milking machines
- Udder towels

Signs of mastitis

1. Blood stains in milk
2. Flakes and clots in milk
3. Discoloured milk

Treatment of mastitis

Use intra mammaries which are antibiotics injected into the affected teats.

Control of mastitis

- The milker must ensure that his hands are clean before milking
- A strip up should be regularly used to test for mastitis
- Before milking, the udder should be washed with warm water and dried using a towel
- The farmer should pay more attention to soars on teats and prevent the plucking by using a milking salve
- The teat cups should be rinsed and disinfected immediately after milking each cow
- Animals suffering from mastitis should be treated promptly to stop the spread of the disease
- Infected animals should be milked last and the milk poured away.

Factors predisposing lactating animals to mastitis

- Stage of lactation; it is more common at the beginning of lactation
- Age of cattle; older animals are more prone to mastitis due an ageing immune system
- Level of milk yield; high milk yielders are more prone to mastitis than the low yielders
- Injury to teat and udder; this makes animal more prone to mastitis
- Unhygienic practices; milking infected animals with health ones increases the chance of mastitis spread

2. **Milk Fever (Parturent Paresis/ Hypocalcaemia)**

It affects cattle, sheep and occasionally goats

Causes

- Low blood calcium and phosphorus level with an increase in magnesium concentration. The normal ratio of calcium phosphorus should not be above or below 2:1.
- Too much calcium in the ration

Symptoms

- It occurs in high milk producing cows soon after calving
- Loss of appetite
- Constipation and general depression
- Muscular spasms (convulsions)
- Uncoordinated movement and inability to stand
- Nervousness is experienced by the animal
- Paralysis and turning of the head back

Prevention

- Feed the cow on a ration containing 0.5 – 0.7% calcium and 0.3 – 0.4% phosphorus
- Calcium shock treatment; feed the pregnant animal 10 – 14 days before calving on a calcium deficient ration to activate the animal's calcium mobilizing mechanism.
- The pregnant animal should be fed on a ration with high vitamin D, six days before calving

Treatment

- The animal should be injected with calcium salts in form of calcium chloride, calcium lactate, and calcium gluconate.

Drying a cow

- The dry period is when a cow is left without giving milk immediately after lactation period. The dry period should be for at least 60 days.

Reasons for observing the dry period

- Allow the cow to restore udder tissues before getting back to lactation
- Allow the cow to replace the minerals depleted during lactation
- To give the foetus enough time to develop and also enough nutrients
- To maintain a high future milk yield in the next lactation

- Enable the cow to gain weight before delivering
- To ensure high quality colostrum at birth

Procedure of drying a cow

- Incomplete milking:
  This involves milking the cow half way its production capacity so that the remaining milk in the udder exerts pressure on the milk secreting cells which will stop secreting milk.
- Intermittent milking:
  The cow is milked at intervals of days and later left completely after 5 days or more.
- Cessation Milking
  This is when milking stopped once for all. It causes a lot of pain to the animal and can easily result into mastitis
- Dry cow therapy:
  Here antibiotics are included in feeds which will control mastitis.

BEEF PRODUCTION

- The main objective of beef production is to produce healthy young stocks, fatten them and sell for slaughter as meat.

Breeds of beef cattle in East Africa

The main indigenous breeds are the boran and small short horned zebus
The exotic breeds are Hereford, Aberdeen Angus, charlolais short horn and Galloway

Characteristics of a good beef breed

- Should have a high ability to mature early
- Should have a high ability to grow fast i.e. put on weight quickly
- Should have thick muscles to increase the quantity of beef produced (have a deep body)
- It should be able to breed regularly so as to increase the herd
- Should have a high ability of converting herbage into beef
- Should have a high resistance to pests and diseases common in the environment
- Should be able to survive long drought periods without losing excessive weight
- Should show a high degree of tolerance to heat

FACTORS LIMITING BEEF PRODUCTION IN UGANDA

1. **Climate**
   Long droughts that are rampant in many places of Uganda have led to the scarcity of pastures and water hence decreasing animal productivity.
2. **Poor Soils**
   Potential areas for beef production have poor soils which cannot support quality pastures for the animal.

3. **Diseases**

There are a number of diseases which attack livestock in Uganda. The most notable diseases are those transmitted by the vectors e.g. ticks and tsetse flies.

4. **Inadequate Extension Services**

Most farmers live in rural areas which are difficult to reach by the extension staff. This denies them an opportunity of acquiring knowledge about beef production.

5. **Conservation**

Most pastoral communities in East Africa look at cattle number rather than the quality hence low production from the large number of poor quality animals in terms of beef.

6. **Poor Markets**

Animal markets are poor and far from the production areas making transport to be difficult and expensive.

7. **Poor Animal Breeding**

Animals are mate while young and little time is spent on selecting the right breeds that are productive.

8. **Poor Management**

This can be reflected in the way records are kept and referred to if necessary. Most farmers do not keep update records and therefore animal production is difficult to judge.

9**. Inadequate land**

Most areas of do not have enough grazing land due to competition between crops and animal production

FACTORS DETERMINING ANIMAL PRODUCTIVITY

Inheritance

This is the most important factor since as the animal received genes of high productivity, and then it can always have the potential. However, productivity is affected by environmental factors which include:

Management

This involves proper care for the animal and observation of signs of ill health

Feeding

Animals that are underfed will have low production and are more prone to diseases.

Diseases

Irrespective of the animal's potential of production diseases will always lower the animal's production.

Climate

Under this, the most important factors are temperature rainfall and humidity. High temperatures of the day increase evaporation of water from the animal's body which reduces milk production in lactating animals.

Humidity

High humidity reduces evaporation of water from the animal's body hence conserving it for other productive purposes like milk secretion.

A part from transmitting pathogens, animal parasites can extract a lot of nutrients that are supposed to be used by the animals' body.

FACTORS TO CONSIDER BEFORE ESTABLISHING A BEEF HERD

Beef cattle may be raised under the farm herd system similar to having a dairy farm, or under the range / ranch cattle system. Under any of these systems, when establishing a beef herd there are a number of factors a farmer may need to consider.

Type of stock

Uniformity
Size of the herd
Health
Condition
Age and longevity
Reproductivity / fertility
Size of cattle
Adaptability

SYSTEMS OF BEEF PRODUCTION

There are a number of systems for beef production requiring different levels of skill and management and some of the systems serve different purposes

Breeding pure bred animals

This is a specialized undertaking and requires great skill and experience in breeding and selection of animals. The purpose is to provide pure breed bulls / replacement stock to other breeders.

Cow and calf systems

Calves are left with their dams until weaning and the cows are not milked. It requires plentiful pasture and little supplementary feeding except in severe dry seasons.

Growing Stockers

Stockers are mainly steers and heifers or thin animals. They are only kept for one year and are fed on pasture. Progressive farmers and ranchers can adequately manage the undertaking. The purposes are to recondition steers and prepare them for fattening and heifers are conditioned for breeding.

Baby Beef Production

This is the production of tender meat from young stock. It involves breeding, rearing and fattening all done on the same farm.

At 4 – 6 months, all the calves are fed on concentrates.

The cows need full feeding in order to produce good calves.

The purpose is to finish the baby beef animals when they are 12 – 18 months old.

Fattening or growing

This involves the fattening of bought in animals after being fed on high energy feeds before selling

Aims of ranch management

1. To decrease the animal fluctuations in stocking numbers
2. To reduce the seasonal fluctuation in live weight of stock
3. To minimize reproductive performance towards the ideal of one calf per cow per year.
4. To minimize calf mortality and losses due to diseases
5. To maintain and improve breeding efficiency.

Factors that determine the size of the herd

- The type of pasture species; high nutritive value of pastures therefore high carrying capacity
- The productivity of the pasture species; high rate of dry matter or forage for grazing means high number of stock
- The type of stock e.g. hardy types which can survive well in drier conditions and scarce pasture can be kept in large numbers.
- Availability of reserve feeds which enable a large herd to be carried through dry periods when pasture is scarce.
- Economic considerations which are usually of a long-term nature e.g. Whether the farmer requires cash immediately and the cost of keeping a large number of animals.
- Topography of the land where over – stocking in hilly areas could result into a serious case of soil erosion.
- Availability of water, sufficient and available at all times
- The presence of poisonous plants and trees that should render portions of the ranch useless.

BEEF CATTLE HEALTH

a) **The Buildings**

- The buildings should be big enough to avoid over crowding
- Should be well ventilated to avoid respiratory infections.
- The floor should be made of concrete which is easy to clean.
- All buildings should be kept clean and be washed out regularly control disease.

- The calf pens should have adequate bedding which should be changed regularly.
- Flies and lice can be controlled by spraying / dusting.

b) **The Grazing Area**

All shrubs and trees which hinder good growth of grass of which could Harbour tsetse flies should be removed.

c) **Water Troughs**

These should be cleaned out twice a week. Murrum should be put around them to avoid muddy conditions that would encourage foot rot.

d) **Breeding**

Cows should be serviced by healthy bulls to control diseases which can be transmitted by breeding or A.I should be used.

e) **Dispensary**

This is mainly for animal drugs that should be kept at hand although some should not be kept by qualified veterinary personnel.

Drugs equipment and material that need to be kept at hand in the ranch dispensary include:

- Healing oil which can be applied on wounds i.e. after castration and dehorning
- Cotton wool for dressing wounds
- Syringes for injecting drug in the bodies of animals
- Sulphur drugs such as sulphurdimidine which is a general drug for oral treatment or injection
- Stilboestrol used in injections on cows after calving, if the after birth is retained and has to be removed.
- Spirit for cleaning wounds and sterilization of instruments
- Terramycin spray for skin wounds
- Terramycin injectable solution which has a wide spectrum and can be used as a general drug against bacterial infections
- Chlorohexidine for disinfecting e.g. cow's udders

BUTCHERY

PROCEDURE OF SLAUHTERING AN ANIMAL

a) **Before Slaughter**

The animals should at all times be handled humanly, rested and starved for 24 hours. This allows emptying of the gut and reduces spoilage and contamination of meat.

The resting also conserves stored body glycogen. After slaughter, glycogen is converted into lactic acid which has a preserving effect on the meat.

Inspection of the animal to check for any deformities, injuries, sex etc. is done at this stage.

b) **Stunning**

This renders the animals senseless just before slaughter to reduce pain. Painless killing of animals is human and it is strongly recommended.

Stunning can be achieved either by use of a hammer gun or electric shock.

c) **Slaughter**

The neck of the animal is cut and its allowed to bleed by hoisting it up. Adequate bleeding is essential to reduce meat spoilage. Skinning is then followed by **devisceration** which is the cutting open of the carcass to remove the internal organs.

d) **Inspection**

This is the postmortem inspection for infection by tuberculosis, cysts etc. The carcass has to be passed for public consumption. Condemned carcasses are buried / burnt.

e) **Grading**

The products looked for are fat, degrees of marbling, texture of meat and colour. A pale colour indicates poor quality

Factors leading to poor quality of meat from animals

1. Poor feeding of animals leading to disease and nutritional deficiencies
2. Poor meat preservation causing putrefaction
3. Diseases in animals that contaminate meat
4. Parasitic infection in animals causing cysts and eggs in meat
5. Age of animals i.e. very young and old animals produce poor quality
6. Poor animal breed that may produce poor quality meat
7. Chemical poisoning of meat by drugs administered shortly before slaughter
8. Harsh treatment of the animal before slaughter through beating

HIDES AND SKINS

Uses

- Used in the leather tanning industry for making shoes, belts, bags etc.
- Source of government revenue when the government taxes the products.
- Making musical equipments e.g. drums
- Decorations in cultural centers
- Used as clothing for traditional ceremonies.

PREPARATION OF HIDES AND SKINS

Washing

This is done in running water with a scrubbing brush to remove dung, dirt and blood

Draining

The hides and skins are hanged over poles to remove water and some blood after washing

Fleshing

This involves the removal of fat and meat from the hide using a knife or scrapper

Trimming

Here, odd flaps at the edge of the hide / skin are removal with an aim of making regular in shape.

Preserving

This can be done by wet/dry salting or hanging them in frames using ropes to dry.

Tanning

This is the process of soaking hides and skins in chemicals such as tannic acid to soften and turn then into leather.

SOURCES OF DAMAGE TO HIDES AND SKINS

a) During the animal's life:

i) Injuries / wounds that may be caused by rough handling and sharp objects such as barbed wire.

ii) Some parasites like ticks can cause wounds which will eventually lower the quality of the hide or skin

iii) Diseases like ringworms in cattle and goats can also damage their skins by causing open wounds

iv) Bad branding more especially at the thigh and back will lower the quality of hides and skins

v) Bad roping can cause calluses and wounds which will eventually lower the quality.

b) During slaughter

i) Incomplete bleeding which causes blood to remain in a hide or skin attracting microbes that may lead to putrefaction.

ii) Dragging carcass on the floor or over sharp objects can damage the hide.

c) During Flaying

i) Delay in flaying after killing the animal will make the whole process more difficult hence prone to more mistakes during flaying.

ii) Use of pointed knives which may accidentally make holes in the hide/skin.

iii) Mixing the hide with dung or blood during the process of flaying the carcass attracting microbe that speed up putrefaction

iv) Failure to wash and dry the skin immediately after flaying can encourage rapid decomposition hence reduction in quality.

v) The fresh skin should not be folded with the hair inside as these creates anaerobic conditions that speeds up putrefaction

vi) An even removal of flesh from the hide causes distortion and damage of the pattern during flaying.

Drying of the skin on the ground can cause the following

a) Causes flaking due to over drying since temperatures are high on the ground.
b) The fat on the skin/hide will melt and spread all over increasing chances of microbial attack.
c) Rain drops can collect on the hide/skin which may easily encourage decomposition and hence loss in quality
d) The outside of the hide/skin is hard while the inside is soft i.e.
e) There is uneven drying.
f) There is putrefaction of the hide/skin more especially in spots which touch the ground

d). Damage during transportation

i) Bad packing causes the hide/skin to rub against each other which may lead to damage
ii) During transportation, rain can soak the hides/skin encouraging microbial action on them.

e). Damage during storage

i) Pests like the rodents and insects can attack the hides while in store more especially if stored in poor houses
ii) Moisture from leaking stores can soak the hide/skins speeding up decomposition

SMALL RUMINANT PRODUCTION

Small ruminant is kept for milk, meat and skins. The main animals here are sheep and goats

Systems of small ruminant production

In East Africa, there are two main systems i.e. **tethering** and **open grazing** though zero grazing is also being practiced in the breeding stock.

Tethering

Here, sheep or goats are tethered using ropes of about 3m long that allows grazing in a limited area.

The animals can be given green supplements on top of tethering.

Open Grazing

The small ruminants are allowed to gaze freely in uncultivated land or a garden with crop residues. This system is common in arid and semi-arid and areas with low human population.

Breeds of goats in Uganda

1. Small East African Goats:

This is the largest breed in Uganda making up to 42% of the total goat population.

Characteristics

i) they are small in size
ii) they mature early reaching a live weight of about 23 – 30kg

iii) they reach sexual maturity at about 4 months
iv) they have a fine hair coat with various colour
v) Most of them are horned and they are mainly kept for meat.

2. **Mubende Goat**

This is found in areas of North and North West of Lake Victoria.

Characteristics

i) It is a larger breed than the small East African goat.
ii) The mature live weight ranges between 30 – 35 kg for males and 25 – 30 for the females
iii) It has straight and short hairs
iv) it is predominantly black in colour though black and white are other colour.
v) It has a long neck
vi) The body conformation of the female is angular

3. **Kigezi**

This is usually found in the highlands of south Western Uganda

Characteristics

i) it has a thicker hairy coat than the other two breeds
ii) it has spaced long hair around the hind quarters
iii) It is small, more compact with short legs.
iv) They have black and grey hair coat
v) At maturity, they can weigh between 25 – 30kg

SHEEP

The main breeds of sheep reared in Uganda are:

i) Red Masai sheep
ii) East African black head sheep
iii) East African long tailed sheep

Advantages of raring small ruminants

- They require small initial capital so poor people can easily start such a venture without much external financial assistance.
- Their reproduction turnover is high i.e. they have short gestation period and frequently deliver twins
- They can be easily managed by family Labour i.e. women and children
- They can be easily kept in mountainous and dry areas where cattle can't do well
- They can be combined with beef cattle utilizing the same land and farm facilities with less competition for food
- Indigenous breeds of these small ruminants are resistant to the number of diseases which affect cattle including East Coast Fever.

- They have a big genetic variation giving room for improvement by selection
- There is ready market for their product more especially meat locally and for export.
- It is safer to keep small ruminant s in areas with cattle rustlers since little interest is accorded to them.
- They can tolerate contamination of drinking water
- Can survive in a wide range of environmental temperatures
- Need limited land for grazing hence good for densely populated areas

Constraints to small ruminant production in Uganda

- Lack of sound breeding males and defective breeding practices
- Most farmers in Uganda have poor management skills
- The animals are attacked by internal parasites which are difficult to control
- The indigenous breeds are being threatened by neglect in preference for the highly productive erotic breeds
- Inadequate extension services amongst farmers limiting information about small ruminants
- The marketing system in Uganda is still poor where animal prices are determined by their size rather than actual weight.

POULTRY

These are birds that have been selected and domesticated by man, e.g.
Domestic fowl, chicken, ducks, Turkey, geese, guineas fowl.

Diagram of a bird Volume 2 (Pg.109)

Importance of poultry

- Provide meat and eggs that are of high nutritive value to the human diet.
- They are a source of income when sold wholly or after selling the eggs.

- Some poultry add beauty to places and therefore are kept for environmental purposes e.g. pigeon. Parrots.
- They provide market for industrial products like feeds, drugs etc.
- They are used for various traditional functions and ceremonies.
- They give quick returns since they grow fast and reach productive stage early.
- Poultry products serve as raw materials for industries e.g. feathers are used in feeling pillows and sofa sets.
- Some poultry especially the chicken provide entertainment in the old game with which fighting practiced in Asia.

Advantages of Poultry over other enterprises

- Poultry does not require a lot of land as compared to cattle.
- It gives faster returns e.g. broilers mature in about 8 weeks and layers in 24 -21 weeks
- Provides many areas of specialization such as egg selling, old chick selling, broiler production etc.
- Chicken meat has low cholesterol and is highly nutritious.
- Poultry are highly prolific
- Poultry farming requires less initial capital

Challenges to poultry farming

- ✓ Inadequate capital needed for raising farm structures
- ✓ Lack of reliable source of poultry feeds
- ✓ Poor poultry housing in relation to environmental conditions
- ✓ Inadequate market for poultry products
- ✓ Inadequate skills in poultry management
- ✓ Poor breeds of poultry being kept
- ✓ Presence of pests and diseases that reduce bird production

Commercial poultry farming.

There are more than 300breeds of chicken in the world. Commercial breeds can be divided into 3 groups.

1. Egg producers e.g. leg horn.

These have the following characteristics: -

i. consume less feeds
ii. produce more eggs
iii. Produce white eggs mainly.
iv. They do not go broody

2. Duo-purpose breeds

i. They have characteristics
ii. They produce brown eggs

iii. Consume more feeds than egg producers

iv. They are better meat producers than the white leghorn.

Example Rhode Island Red, New Hampshire.

3. Meat producers (Broiler)

Characteristics

i. They have a low egg production capacity.

ii. They show much broodiness than the other two.

iii. Produce fast growing chicks

iv. Have a high weight at maturity

Examples white Cornish, white Plymouth.

Characteristics of a good poultry house.

- It should be water proof to avoid dump conditions in the house that can easily invite pathogens.
- It should have proper ventilation to control respiratory infections.
- It should have a concrete floor which is easy to clean.
- Should be rodent and wild bird proof to avoid spread of diseases.
- Should be located within outer of the owner for security
- House should be well sheltered from direct sunshine and strong winds.
- The place where the house is to be constructed should be well drained.
- Should be an accessible place so that birds and eggs are easily removed when necessary and taken to the market.
- Should have enough laying boxes in case of layers to reduce rises specifically egg eating.
- Should have enough litter in relation to the bird population.

THE DIGESTIVE SYSTEM

1. Beak

Its composed of two horny parts i.e. the upper and lower beak. It picks food and passes it to the crop via the gullet.

2. Gullet

These acts as a passage for food from the mouth to the crop.

3. Crop

Stores food before proceeding to the glandular stomach. It also softens the food.

4. Glandular stomach.

This is an enlarged part just before the gizzard. Its wall contains many glands that secrete hydrochloric acid. Its also referred to as the first stomach.

5. Gizzard / muscular stomach

This is the real stomach of the chicken with very muscular walls. It grinds down the feeds to increase action by gastric juice enzyme. It contains grease which is taken up with food.

6. Small intestines.

The 1st part forms the duodenal loop where most of the digestion takes place. Its about 1.5 long in an adult chicken.

Digestion of fats, proteins and carbohydrates takes place here.

7. Caeca

This lies between the small and large intestines and it's also called the blind gut. Digestion of crude fibre takes place here due to the presence of bacteria.

8. Large intestines / colon.

Its relatively short of [about 1cm] and its were absorption of moisture takes place.

9. Vent / cloaca /Common sewer

The digestive, urinary, and productive trait empty here their products.

REPRODUCTIVE SYSTEM OF POULTRY

It comprises of the following: infundibulum, magnum, uterus, vagina, and isthmus.

Infundibulum

Its where fertilization takes place and also the formation of yolk sac takes place here.

The egg takes about ¼ an hour while here.

Magnum

This is where 45% of the albumen and the chalazae are formed. The egg takes about 3 hrs here.

Isthmus

This is where 10% of the egg white is added. The egg membranes are also formed here and the egg takes between 1 ¼ hr while here.

Uterus / shell gland

In this place the outer calcium shell is added to the egg and 45% of the albumen is also added. The egg spends 18-22hrs while here.

Vagina

The egg is inverted in this place and vaginal fluid is secreted to reduce friction. The egg spends about one minute before moving to the cloaca.

ABNORMALITIES THAT OCCUR IN EGGS DURING FORMATION

Meat spots; a piece of tissue is torn off the ovary during ovulation. It comes down with the yolk resulting into a blood spot

Blood spots; a drop of blood is shed off the ovary during ovulation and comes along with the yolk resulting into blood spot.

Double yolk; two ova are shed at ago by the ovary later being enclosed in the same shell.

Shell less eggs; nutritional imbalances and defects in the shell gland cause failure of the shell to be deposited on the egg during formation

Thin shell; disease and nutritional imbalances lead to the laying of eggs with thin shells

Deformed eggs; eggs with abnormal shapes due to defects in the isthmus where the shape of the egg is determined

Eggs with rough surface; uneven deposition of the shell on the egg leads to the formation of such eggs

Soft shelled eggs; failure of shell gland to deposit a hard shell due to inadequate calcium in the diet or other defects

Small sized eggs; these may be due to poor feeding or hormonal imbalances

Abnormal smell of the yolk; it may be due to diseases of poor feeds eaten

Factors that determine the level of laying in birds

1. Level of feeding; giving adequate amount of feeds leads to high level of laying
2. Quality of feeds give; well-balanced ration ensures high production of eggs
3. Health of bids; sick birds will lay less eggs of poor quality
4. Pest attack; pests cause stress in birds which lowers egg production
5. Temperature in poultry house; high temperature reduces feed and water intake which will lower egg production
6. Breed; high laying breed produce more eggs than the meat producers
7. Provision of enough water; giving less water affects body metabolism which may lower egg production
8. Ventilation; poor ventilation in the poultry causes stress which reduces egg production

SYSTEMS OF POULTRY PRODUCTION

They can be divided into three major groups i.e. extensive system, [free range], semi intensive [fold system and poultry run] and Intensive system [cage and deep litter system]

1. EXTENSIVE SYSTEM

In this system the birds are allowed to move freely over large area of grass land where they experience nearly natural or wild conditions.

The birds are not confined and during bad weather the birds can find shelter under natural covers like trees.

Advantages of free range

- Manure is spread all over the field or in any place where the birds eat from.
- The system is less expensive as compared to the deep litter and battery system since it requires little initial capital
- Birds will be able to get enough exercise which is good for their health as they move allover the place.
- Birds get almost all the nutrients required in their diet from the environment more especially vitamins.
- Vices are not common in this system as observed in deep litter system.
- It's a good system for the management of the breeding stock because it enables the birds to become hardy and strong
- Birds are able to get vitamin A and D from the environment.
- Requires less Labour which reduces operational costs hence increasing profits

Disadvantages

- Birds can easily be attacked by wild animals
- It's very difficult to collect the eggs since sometimes they are laid in bushes.
- The birds are more prone to parasitic attack from the environment.
- It's very difficult to keep feeding and production records under this system since birds cannot be easily monitored.
- Birds can easily get diseases from others of a different stock in the neighborhood.
- The production from these birds is low since they spend a lot of energy meant for production in movement.
- The system cannot easily support exotic birds that cannot tolerate harsh conditions.

POULTRY RUN

In this system birds are rotated in paddocks for a particular period of time during day. They are later confirmed at night.

Advantages

- It requires far less land than the free range system
- It's suitable for commercial egg production as compared to the free range since clean eggs are easily produced.
- It doesn't require expensive equipment therefore has a low initial capital.
- Birds are protected against thieves and wild animals.

- Spread of diseases from out side stocks is under control.

Disadvantages

- There is a high risk of disease as land becomes contaminated with parasites.
- The eggs may be dirty and therefore of low quality.
- Costs are high in terms of feeding, fencing, and housing.

FOLD SYSTEM

Here birds live old the time in a simple design and partially roofed structure which is movable. The fold unit is systematically moved daily over an area and therefore must be of size and weight which is easily moved.

Advantages

- It's easy to inspect birds and isolate sick ones.
- Manure is distributed evenly on the farm
- Birds are well protected against predators and thieves.
- The system can be used for commercial egg production.
- It's a more ideal system of raising breeding stock since birds are exposed to natural conditions that makes them hardy.
- Production is higher than the free range since birds spend less energy.

Disadvantages

- It may not be used easily on a ground which is not flat because the unit may be difficult to move.
- The system can accommodate a few birds so as to allow easy movement of the unit.
- The unit is quite expensive therefore may not be affordable to peasants.
- Birds' performance is affected by change in the environment.

BATTERY / CAGE SYSTEM

This is an intensive system of poultry production were birds are kept in individual cages indoor of about $0.14m^2$.

Feeders and drinkers are arranged at one side.

The wire making up the floor is slated to allow eggs roll to one side for easy collection.

Food and water may be mechanically provided or using computerized system.

The floor beneath the cages is made of concrete slanting at one side for easy drainage and cleaning

Advantages of cage system

- Reduce chances of vices like cannibalism since birds are confined in individual cages.
- Feed and water contamination with droppings is reduced since water and feed troughs are locate higher at one end.
- Clean eggs can be easily produced.
- It is easy to keep individual feeding and egg production records.
- Disease spread easily controlled since birds are confined.
- Bullying amongst birds is easily controlled since birds are under confinement.
- It requires less Labour for management of large flocks.
- A large number of birds can be kept on a small piece of land
- Bird production is high since they spend less energy in movement.
- Culling out of birds is to carry out since they are in close observation

Disadvantages

- It requires a high initial capital for installing cages and other equipment.
- Birds lack exercise which may affect their health
- It may require skilled Labour to run the system
- There is a danger of concentrating parasites in the poultry unit
- Birds may not get vitamins like D from the environment

DEEP LITTER SYSTEM

This is the most common and popular modern system of keeping commercial poultry. Birds are confined in a house on litter of about 20cm deep which has to absorb moisture from the droppings. Materials used for litter are coffee husks woods and having chopped straw and rice husks.
Litter is turned frequently to mix it with droppings thoroughly and more materials added

Advantages

- It requires a small area of land to raise large number of birds.
- Its easy to control birds since they are confined in one place
- Birds are protected from predators and thieves.
- It gives comfort to both attendant and the birds since there is little wastage energy and time in feeding and collection of eggs.

- Manure obtained under this system is of high quality
- Records of stock and egg production are easy to keep under this system.
- It's easy to observe sick birds in the flock hence easy to cull out such birds.
- Spread of disease from the neighborhood is easily controlled since birds are confirmed.

Disadvantages

- The system encourages the build up of parasites in the litter unless turned, treated and replaced regularly.
- Its may require more Labour in terms of feeding and collection of eggs as compared to the free range system.
- Its difficult to control diseases incase of an outbreak within the deep litter house.
- Birds easily develop vices more especially due to over crowding within the deep litter house.
- It's difficult to keep individual production records.
- It's expensive to establish since money is needed for the construction of houses and purchase of the necessary equipment.
- Feeders, waterers, and nesting boxes are easily contaminated with litter and droppings which may lead to disease.
- Comfortable litter in poultry house may induce birds to go broody.

MANAGEMENT OF LAYERS IN A DEEP LITTER HOUSE

- Provide enough space in the house to control overcrowding that result into vices and disease outbreak
- Keep the litter dry by continuous raking and removal of wet spots to control dampness that encourages disease outbreak
- Provide enough perches for the birds and they should be well spaced
- Provide enough water and feed troughs to reduce overcrowding at the feeding and drinking place which increase feed and water contamination
- Provide clean drinking water at all times for proper bird health and high production
- Keep feeders and drinkers clean to reduce disease outbreaks due unhygienic conditions
- Provide adequate feeds to birds to maintain a high production level
- Collect the eggs regularly to reduce chances of breaking and occurrence of egg eating vice
- Supply grit in feeds to help birds to digest grains in the feeds provided

- Cull poor layers and diseased birds to reduce wastage of feeds and disease spread in poultry
- Vaccinate birds against killer diseases in time to reduce losses
- Spray birds with pesticides to control external parasites like mites and ticks that may lower production
- Avoid stressing factors that may affect bird production
- Repair equipment and house to reduce accidents
- Provide enough feeds to ensure high production from birds
- Isolate and treat sick birds to reduce disease spread in poultry
- Keep proper records for easy management of poultry
- Promptly dispose off dead birds by burying or burning to reduce disease spread and vices
- Maintain a disinfectant at the door for any body entering the poultry house to disinfect himself.

Causes of disease outbreak in poultry houses

- Introduction of sick birds in poultry house
- Mating between sick and health birds
- Contaminated vaccination equipment
- Contaminated water and feeds given to birds
- Poor disposal of dead birds
- Visitors and attendants who move from one farm to another
- Introduction of disease carriers to the poultry farm
- Direct contact between health and diseased birds
- Through infected eggs to chicks
- Vectors and wild birds that may come into contact with poultry
- Through contaminated drinkers and feeders
- Overcrowding in poultry house
- Poor ventilation in the house leading to respiratory infections

Control of disease outbreaks in poultry houses

- Regular vaccination of birds to control killer diseases
- Provision of coccidiostats in feeds to control coccidiosis
- Providing clean feeds and water
- Regular deworming to control internal parasites
- Provide enough high quality litter for to control respiratory infections
- Do not mix young and old birds since the former are more prone to disease
- Avoid unnecessary visitors in the poultry houses
- Provide a disinfectant at the door way

- Dead birds should properly disposed
- Isolate the sick birds to control disease spread
- Raise feeders and drinkers to reduce contamination by litter
- Regular cleaning of feeders and drinkers
- Buy birds from reliable sources that show less instance of disease
- Provide a balanced diet to control nutritional deficiency diseases
- Keep proper records on vaccinations
- Provide adequate feeds to birds

MAINTANANCE OF GOOD LITTER IN A POULTRY HOUSE

1. Periodic racking to remove feathers and spreading of droppings.
2. Removal of wet litter spots
3. Addition of agricultural lime at a rate of 4g/10m2 to increase moisture absorption.
4. Removal of litter after the laying cycle.

Characteristics of good litter

- ✓ It should not cake up
- ✓ Should cheap to the farmers to afford
- ✓ It should not be dusty
- ✓ Should not be poisonous to the birds
- ✓ Should be pest free
- ✓ Should not be bulky
- ✓ Should be a good moisture absorbed
- ✓ Should not be too dry

Causes of wetness in litter

1. Drinking water that may splash over the litter as birds drink it
2. Moisture from chicken droppings
3. Rain water from leaking roof
4. Capillary water from underground in poorly drained places
5. Rain water through the windows during storms due to a short overhang of the poultry house
6. Flooding of the site
7. Overcrowding of birds that increases humidity
8. Accumulation of bird dropping
9. Poor ventilation that increases humidity

VICES IN POULTRY

A vice is a bad behavior practiced by birds e.g. egg eating feather pecking, cannibalism.

Causes of vices

1. Heredity: some line of birds show more vices like cannibalism than others.
2. overcrowding is the poultry houses can cause vices like cannibalism as birds become more close to each other
3. Introduction of new birds in a flock with unique characters of the body and size may cause cannibalism and feather pecking.
4. Exposure of wounds and smell of blood can cause cannibalism
5. Lack of enough laying boxes which causes breakage of eggs and exposes eggs to the birds can easily result into egg eating.
6. Improper feeding of the birds that encourages mineral deficiency can lead to cannibalism
7. Bright light in the poultry house can stimulate feather and toe pecking.
8. Insufficient drinking and eating place may also lead to pecking as birds struggle to get near to feeds and water.
9. Irritation of the skin through direct sunlight and lice infection can result into cannibalism and pecking.
10. Diseases like gumboro can easily cause cloaca pecking since the droppings usually stick in that area.
11. Introduction of birds that are moulting (shedding feathers) in a flock can easily encourage cannibalism due to exposure of bare skin to other birds.

Control of vices

1. The farmer should provide enough laying boxes that should be placed in easy to reach dark places.
2. The birds should be debeaked between 9 – 12 weeks in order to control egg eating.
3. Give the birds balanced feeds to reduce the laying of soft shelled eggs that easily break and cause egg eating.
4. Over crowding of the birds in the poultry house should be avoided by reducing the stocking rate.
5. Greens to be fed to the birds should be hanged over their heads so that birds are kept busy.
6. Sick birds and weak ones should be isolated from the general flock to control cannibalism.
7. The farmer should remove all the slow moulting birds from the general flock since such birds encourage cannibalism.

8. The breeding stock should be selected from the birds that do not show any sign of vices.
9. The nests should be enough and must be well positioned to reduce accidents that can cause breaking of the eggs resulting into egg eating.
10. There should be enough feeds and water troughs for the birds.
11. Birds with lice infection and gumboro disease should be culled.
12. The farmer should treat external parasites and prevent diseases in the flock through vaccination.

STRESS IN BIRDS;

This is the response of birds to a situation that troubles it

Causes of stress in birds;

1. Change of feeds i.e. from layers mash to growers mash
2. Change of feeding routine
3. Starving birds or inadequate feeding
4. Vaccination of birds leading to pain
5. Debeaking birds
6. High temperatures in the poultry house
7. Presence of parasites on the birds
8. Overcrowding in poultry house
9. Change of the environment around the birds i.e. moving birds to a new place
10. Noise of predators around the poultry house

Effects of stress

1. Reduce egg production in birds
2. Reduce bird appetite
3. May cause disease in birds
4. can reduce growth rate in young birds

Question; explain how a farmer may control stress in birds

Characteristics of a good laying bird:

	Good layer	**Bad layer**
Comb / wattle	They are large, red in colour and full	They are dry pale and scaly
Eyes	They are keen and sparkling	They are sunken and dull

Beak	It is short and colourless in most cases	Beak is long and yellow
Distance between the pelvic bone	3 -4 fingers can fit in the space	It narrow allowing between 1 -2 fingers
Skin	Its smooth and warm	Hard and dry
Cloaca / vent	It is oval, large and moist	It is round small and dry
Weight	Normal in accordance with breed	Too heavy because of too much fat and light due to illness
Belly	Normal size, soft and smooth	To big or too small

SELECTION OF HATCHABLE EGGS

1. Eggs selected should be fertilized therefore to ensure this a hen should stay with a cock for Atleast a week before laying at a ratio of 1 cock -12 hens.
2. Eggs of uniform size and shape should be selected for uniform distribution of heat during incubation.
3. Ensure that you select clean eggs.
4. Ensure that eggs selected have thick shells with no cracks to prevent breakage during turning and attack by microbes.
5. Eggs with abnormalities like meat and blood spots should not be selected.
6. Hands handling those eggs should be clean to avoid transmission of diseases.
7. Eggs should be from healthy birds [i.e. not from infected birds with coccidiosis, bacillary white diarrhea] which can easily be transmitted.

INCUBATION OF EGGS

This is the embryonic development of fertilized egg into a chick. The period Varies between different birds.

METHODS OF INCUBATION

There are two main methods of incubating eggs i.e.

Natural incubation

Artificial incubation

Natural incubation

This is where a broody hen seats on a clutch of eggs to provide conditions suitable for hatching to occur. Like humidity optimum temperature and adequate
air supply.

In order to achieve the above conditions the hen does the following:-

1. It changes / turns her eggs using its beak so that all the sides of the egg get the same temperature.
2. The hen moves out quite often to allow the eggs cool down when the temperature rises and also to allow air circulate around the eggs.
3. The hen may sunbath and may get its chest wet so that when it goes back it can give the required humidity to the eggs.

Improvement of natural incubation

1. Make a good nest for the hen to guard against egg breaking.
2. Place the nest in a quiet corner at ground level for easy reach.
3. Provide plenty of clean water and enough food so that the hen does not spend much time looking for them
4. Protect the hen from parasites like mites and vermin by dusting the nest with doom or any other pesticides.
5. Dump the nest daily during drought to provide the required humidity.
6. Ensure that the hen is with the cock during and before laying time to ensure that the eggs laid are fertilized.
7. Remove oversized and undersized eggs or these with abnormalities before the hen starts incubating.

ARTIFICIAL INCUBATION

Under the modern machine called an incubator is used in the incubation of eggs.

Factors essential for incubation and proper hatching of eggs:

1. Temperature:

This has to be effectively controlled between 32.2^0C – 37.2^0C. Higher temperatures can cause death of embryos especially from the 19^{th} day of incubation onwards.

Chicks hatched from high temperatures are smaller, lack alertness, have crooked
toes, and necks. While low temperatures cause late and poor hatchability of eggs.

2. Humidity:

Chicken eggs require humidity of 60% during the 1st 18 days then 70% later. Low humidity causes excessive loss of moisture from eggs resulting into small and hard chicks. High humidity may result into large chicks and may delay hatching.

3. Air supply

21% oxygen is required in the incubator to allow adequate gas exchange between the embryo and out side

4. Turning of eggs.

Eggs should be turned for the first 18 days of incubation once every 3hrs. After

18 days there must be no turning. This prevents embryos from sticking to one side

5 Egg must not have any defects like cracks and double yolks since such may not hatch

6 Providing a good nesting place to avoid breakage of eggs

7 Ensuring that the place of incubation is free from pests and vermin

8 Providing a balanced diet for the broody hen in natural incubation

MANAGEMENT IN A HATCHERY

Hatchery sanitation is required to prevent infection in younger chicks. Diseases

that can affect chicks in mismanagement hatcheries are new castle, Coccidiosis and other respiratory diseases. It's advisable to do the following:-

i. Clean and fumigate the incubator / hatchery before setting in eggs.
ii. Select clean eggs and fumigate them before incubation.
iii. The hatchery should be located far away from any nearby poultry farm.
iv. Have the incubator in a separate from where you meet people.
v. Do not allow visitors in the hatchery except the hatchery attendant.
vi. Vaccinate chicks against new castle immediately after hatching.

SEXING OF CHICKS

Sexing is the grouping of chicks according to their sex.

Methods of sexing

1. Vent method

This is based on observation of the vent where the make chicks have three Protuberances (round part that sticks out) from the vent while the female have only two.

2. Chick – sexing machine.

The machine uses magnifying lenses to see through the vent of the chicks in order to determine their sex by observing the internal reproduction systems.

3. Auto-sexing method.

This takes advantage of the sex linked genes that depict the external traits of the offspring according to sex. E.g. the cross between a light Sussex hen [white] and a brown Rhode Island cock will produce brown females and white males in F_1 generation.

BROODING

It's the prevision of warmth for growing chicks. A broader is a structure where chicks are reared from day old up to 6 or 8 weeks of age.

Types of brooders.

1. Warm floor brooder
2. Infrared brooder.
3. Tier brooder
4. Hot-room brooding.
5. Cold-room brooding.

PREPARATION TO RECEIVE DAY OLD CHICKS

a. A week before arrival.

1. Clean and disinfect the house thoroughly
2. Install all necessary equipments after cleaning has been done e.g. water troughs, food, litter etc.
3. Prepare the disinfected bath at the entrance
4. Keep rats, mice and other pests out of the house by sealing off all entrances.
5. The brooder house should be made wild bird proof to reduce spread of diseases.
6. Reduce air flow into the house by placing curtains or mats in the windows.
7. The house should be locked to keep out any intruder.

24 hours before arrival of chicks.

1. Ensure that the temperatures are not below 28^0C by providing a heat source.
2. Set up a brood guard around the heat source to protect chicks from the heat source.
3. Hung a thermometer in each brooder guard to monitor the temperatures of the heat source.
4. Check all bulbs to ensure that they are in good order to provide light intensity of about $4W/M^2$ of floor area.

5. The bulbs should be hanged atleast 2m high so that they can give enough light over a wide area.
6. Put / lay down mold free litter to a minimum depth of 5cm and cover it with paper.
7. Put clean feeders around the brooder guard like spokes of a wheel.
8. Provide 2 – 3 drinkers for every hundred chicks depending on the type.
9. The bird population per brooder preferably shouldn't exceed 200 as management becomes very difficult.

Arrival of chicks up to 1st week.

1. Observe strict sanitation during the un loading of the chicks.
2. Chicks should be removed from boxes as promptly as possible to reduce mortality.
3. Put filled drinkers in space so that the chicks can start drinking water mixed with glucose.
4. Chicks should be given good quality starter mash ration.
5. The temperatures of the brooder should be maintained between 33-34^{0}C.
6. Seal off all cavities around the brooder and corners to prevent chicks from crowding there.
7. Clean water should be provided continuously through out the day and night.
8. Provide grit [chick size] from 2nd day onwards to help in digestion.
9. Relative humidity in the brooder should range from 60 – 80%
10. Gradually expand the brooder area as the chicks grow.
11. Room temperatures should be maintained at 32^{0}C within the 1st week.
12. Check whether there are chicks soiled with feaces on the vent area and remove such to prevent constipation.
13. Dead chicks should be removed as soon as the possible to control vices and spread diseases.
14. Paper covering the litter should be removed as soon as chicks learn to identify the feeds.

Second week

1. Room temperatures should be gradually reduced to about 30^{0}C as chicks develop feathers.
2. Remove the brooder guards completely.
3. Start ventilation at a low rate when atmospheric conditions are favourable.

4. Put in additional feeders and locate them far away from the heat source.
5. If mortality is higher than normal, a specialist should be called in for advice.
6. The mats in the windows should be removed gradually and the farmer should be aware of dust storms, strong winds and cold.

3rd week

1. The room temperature should be lowered to about 28^0C or even lower than this up to 25^0C.
2. Changing to automatic feeders and drinkers must be done gradually.
3. Reduce light intensity to about 2.8W m^2 of floor area.
4. Provide plenty of clean fresh drinking water for the birds.
5. All birds with deformities / abnormalities should be culled at this level.
6. Ensure that there is no left over food in the troughs over night.

4th week

1. Light intensity should be reduced to 2W/M^2 of floor area and should be followed strictly.
2. Weight of the birds should be taken in order to determine the growth rate.
3. Make a change from starter marsh to growers mash gradually.
4. Adopt an established feeding programme and stick to it for economic purposes.
5. Should cannibalism occur, try to stop it by debeaking the birds.

5 – 10 weeks

1. The stoking rate of the poultry house should be 9 – 12 birds per metre squared of floor space depending on the housing system.
2. Switch over from chick size grit to grower size.
3. Select the breeder birds for meat production.
4. Ensure that the feeding space per bird is 10cm and the drinking space is 2cm per bird.
5. Debeaking should be done for birds kept in cages.
6. Compare the bird's weight record with standard body weight for the same age.

Qualities of a good breeding stock

1. Should be free from defects like lameness etc.
2. It should be of good colour.

3. It should be able to mature sexually early.
4. It should have a high laying rate.
5. It should not have pauses in egg laying.
6. It should be non broodiness.
7. It should produce eggs with no abnormalities.
8. It should be able to lay eggs for along period of time.
9. Should be able to produce good quality chicks.
10. Should have a good body size incase broilers
11. Should have a rapid growth rate.
12. Eggs produced should have high hatchability.
13. It should produce chicks with low mortality
14. It should be early feathering to reduce the chances of cannibalism.

Factors to consider when planning a vaccination programme for birds.

1. Age of the bird

Some vaccines are administered to day old chicks e.g. new cattle diseases or After a week.

2. Genetic resistance of the flock.

If a flock is resistant to a certain disease naturally then vaccination may not be needed.

3. Health status of the bird.

Vaccines should be administered to healthy birds not sick ones since it may not serve the purpose.

4. Feeding and management practices followed.
5. Methods of administration of the vaccine.
6. Methods of storage and available facilities.

Precautions to take during vaccination of birds.

1. Follow the manufacturer's instructions regarding the use of vaccines.
2. Avoid exposing vaccines to high temperatures during transit.
3. Store vaccines in a deep freezer before use.
4. Do not vaccinate birds when they are under stress.
5. Do not mix two vaccines together while administering
6. Use distilled water incase you want to reconstitute the vaccine.

7. Anti stress medicine like antibiotics and vitamins should be given to birds before vaccination.
8. All birds in the poultry house should be vaccinated at one time.
9. Vaccination should be carried out in the cool hours of the day.
10. The equipment to be used in the vaccination process should be disinfected.

PIG PRODUCTION

Terms used

1. **Sow;** This is a female pig, which has already farrowed

2. **Boar;** It's a male mature pig.

3. **Gilt;** A young female pig, which has not yet farrowed.

4. **Piglet.;** The young of a pig [newly born pigs]

5. **Farrowing;** The act of giving birth in pigs.

6. **Runt;** The last born among piglets.

7. **Farrowing pen;** This is a special place where pigs farrow from

8. **Pigsty;** This is a house where pigs stay

9. **Pork;** Fresh meat from pigs.

11. **Bacon;** This is meat taken from sides and back of the pig and cured in the factory.

SYSTEMS OF PIG REARING

Intensive system; this is where the pigs are confined in houses through out their life

Semi-intensive system; this is where the pigs are confined in houses at most period of the day and allowed out for a short time

Extensive system; pigs are allowed roam the place in search for water and feeds

Question; *explain the merits and demerits of each system*

Advantages of rearing pigs.

1. Pigs require a small area since they can be confined under the intensive system of management and do not require a large area of grazing as ruminants do.
2. Little initial capital is required as compared to dairying and fish farming.
3. They consume most of the food remains reducing wastage of feeds on the farm and lowering feed costs.
4. Pigs grow very fast which enables the farmer to get income in a short time when sold.
5 It is adapted to specialized and diversified farming system
6. They produce high quality manure which can be used in the gardens.
7. Pig rearing creates extra employment for the family and the population especially in places with established pig industries.
8. Pigs produce hard fat that can be used in the manufacture of soap.
9. Pork is easily marketable
10. Pigs are highly prolific which increases profits faster

Factors to consider before starting a pig enterprise.

1. **Type of breed.**

The breed chosen should be the one needed in the market and one adopted with
the environment

2. **Food supply**

A constant supply of feeds is necessary since pigs quickly respond to inadequate
feeding.

3. **Capital**

This is needed for purchasing the breeding stock, constructing pig houses, buying feeds etc.

4. **Labour.**

Skilled Labour is required for proper carrying out of management practices like feeding pregnancy diagnosis and gilt, removing chick.

5. **Housing**

Good housing improves pig production hence it should be put into consideration.

6. **Transport facilities**

There must be reliable transport in the area from breeding centres to the market

7. **Market.**

There must be ready market for the animals and their product to reduce losses.

8. **Economy of production**

Large scale production requires high initial capital therefore a farmer must be ready to meet it.

9. **Pest and diseases.**

The history of pests and diseases in a particular place should be considered since some diseases like swine fever can cause a lot of losses.

Problems facing the pig industry.

1. Diseases

A serious disease like swine fever / hog cholera has caused serious losses to farmers in the pig industry.

2. Pigs are non ruminant hence complete with man for the little food available.
3. Social beliefs.

A number of societies in Uganda look down at a pig as a an unclean animal therefore they cannot rare or eat products from the animal.

4. Pigs have a vice of uprooting plants and destroying farm structures which makes their raring expensive.
5. Pig production requires a special kind of fence which may be expensive for most farmers.
6. Inadequate organized market.

Most of the pork / pig butchers are located in restricted places which makes

marketing difficult.

7. Poor breeds of pigs.

Most of the breeds being kept are of poor quality and hence they are of low production.

8. Poor management

Most of the farmers have little knowledge about pig management.
This reduces growth rates hence a low level of production.

PIG BREEDS IN UGANDA

1. Large black
2. Large white / Yorkshire
3. Land race
4. Saddle back.

SELECTION OF BREEDING PIGS.

1. **Boars**
   - It should be vigorous and healthy
   - It should have well developed feet
   - It should be free from defects that can be transmitted to off springs.
   - Should have a long, deep and strong body.
   - It should be easy to handle i.e. should have good temperament.
   - They should be able to weigh about 100kg at six months of age.
   - The appearance and condition of the pig /boar should confirm the breed type.
   - It should be able to mature sexually early.
   - It should be able to produce large quantities of viable sperm

Qualities of good gilt

- Should have well developed feet to enable her feed the litter even when standing.
- It should have god mothering quality i.e. a low temperament.
- It should be healthy and having a vigorous build
- The appearance should be in conformity with the breed
- It should have atleast 12 functional teats to enable her raise a large number of litter.
- It should be able to farrow without any problem
- Should have a high ability to utilize feeds efficiently.

- Should be able to produce atleast 8 piglets per farrow
- Should produce piglets with a high growth rate.

CARE FOR A PREGNANT PIG.

- Feeding

The saw of gilt should be given a feeds/ sow and weaner meal which is 2% of its weight per day.

- Individual feeding troughs should be encouraged to reduce competition between the pregnant animals.
- In the 1st month of pregnancy give about 2.4 – 3.5 kg of sow and weaner meal per day.
- Do not over feed the animal during pregnancy to avoid over feeding and stocking of the udder which causes mastitis.
- During the second and 3rd month sow and weaner feeds should be reduced to about 1.5 per saw per day.
- Bulky feeds like sweet potatoes and cassava should be given to make a balanced diet and improve digestion.
- Clean fresh water must be made available at all times which can be mixed with feeds or given after eating.
- The pregnant animal should be dewormed before farrowing to control internal worms e.g. tape worm.
- Minerals and vitamins should be given in correct amounts e.g some vitamins which are important in embryo development.
- A sow should be taken in a clean farrowing pen two weeks to farrowing.
- Supply 10-15kgs of dry grass to the farrowing pen which can be used by a pregnant animal uses a nest.
- Administer an iron injection to the pregnant animal to control anemia in the piglets about to be born.
- The gilt also should be washed especially the udder with clean water and soap a few minutes to farrowing to remove dirt and worm eggs.

SIGNS OF FARROWING:

i. The sow/ gilt becomes restless
ii. Presence of milk with in teats 12 – 24 hrs before farrowing
iii. Enlarged teats of the gilt or sow.
iv. The vulva becomes swollen and enlarged.
v. Muscles on either side of the tail slacken
vi. The sow prepares a nest from the dry grass.
vii. Arching of the sow's back.

Preparation for farrowing

a. Clean and disinfect the farrowing pen
b. Wash and disinfect the pregnant animal
c. Treat the animal against internal parasites
d. Move the animal to the farrowing pen
e. Secure the animals feed a day before farrowing
f. Provide heat in the farrowing creep area
g. Provide clean beddings

MANAGEMENT OF PIGLETS FROM BIRTH TO WEANING

1. Feeding
   i. Piglets should be left with the mother to ensure that they take colostrum which is important to their bodies.
   ii. They should be provided with feeds rich in proteins and carbohydrates [creep feed] in a special place only accessible by piglets [creep]
   iii. Clean water should be provided to the piglets at all times.

2. Control of piglets anaemia.

Piglets should be given an ion injection or anthill soil rich in ion.

3. Identification

Two main methods are used in the identification i.e. ear notching and ear tattooing.

4. Teeth clipping/ removal of cheek teeth.

The sharp canines should be removed since they become dangerous at a later stage to the managers

5. Deworming

The piglets are more prone to internal worms like liver-fluke, tape warms and round worms. They should be dewormed early to ensure fast growth.

6. Castration

The male piglets that are not going to participate in breeding should be castrated
at about 2 weeks of age

7. Vaccination

The piglets can be vaccinated against killer diseases like foot and mouth etc.

8. Weaning

The piglets are weaned at about six weeks after delivery and thereafter they should be fed normally on concentrate feeds

Management of gilts from weaning to farrowing

- Feed the gilt on Atleast 3kg of sow and weaner meal every day
- Provide clean water without any restriction
- Vaccinate the gilts against killer disease regularly
- Control external parasites like lice by spraying or washing using pesticides
- Sick gilts should be treated immediately o avoid loss
- The gilt should be mated at about 12 month after attaining 45 kg.
- Flush the animal 3-4 weeks before mating to increase rate of ovulation and successful fertilization
- Keep the pen clean to reduce disease out breaks by regular washing
- Once ready, the gilt should be taken to the boar and left there for 12 hours
- Observe the gilt to ensure that it has conceived if not, take it back for service
- Steaming up should be done 1 month to farrowing
- Wash the gilt prior to calving to remove worm eggs from the teats

METHODS OF FEEDING PIGS.

Ad-lib

This is where pigs are allowed to eat as much as they want since feeds are always available.

Semi adlib feeding

This involves feeding pigs 3 times a day by hand as much as each would eat in 20 –

30 minutes

Restricted feeding

Pigs are fed once or twice a day.

SYSTEMS OF FEEDING PIGS.

1. Automatic feeders

This is where feeds are provided to pigs in their stores by a computerized system

2. Trough feeding

Here feeds are given in troughs.

3. On floor feeding

Here feeds are poured on the floor more especially the dry feeds for pigs to eat.

ADVANTAGES OF FEEDING PASTURES TO PIGS.

1. Improve functioning of the digestive system
2. They are the cheapest source of animal feeds
3. They are a good source of minerals and vitamins for grazing animals
4. They easily satisfy the animal's appetite since they are abundant and taken in large quantities.
5. They protect and restore fertility in the soil.

ANIMAL NUTRITION.

Nutrition is a process by which living things receive food necessary for them to grow and be healthy.

A nutrient is a substance that is needed to keep a living thing alive and help it Grow

Terms used in animal nutrition.

Ration. This is the amount of food needed by an animal in a day.

Balanced ration This is a ration that contains nutrients needed for both maintenance and production

Maintenance ration This is the amount of food required by an animal to keep it healthy and alive in good health without gain or loss of weight.

Production ration. This is the food required by an animal over and above maintenance ration for additional output / performance e.g. milk production, egg production, fattening, growth etc.

Digestibility. This is the measure of that proportion of food eaten by an animal less that lost through feaces or the proportion of food absorbed in the body less that lost in feaces.

Digestible crude protein This is the measure of N_2 in the feed consumed and retained in the body of the animal after subtracting that lost through feaces, urine and gasses.

Starch equivalent. This is the amount of pure starch which has the same energy as a 100 kg of a particular feed

Total digestible nutrient. This is the sum total of all digestible nutrients in a feed.

Crude protein The rough measure of the amounts of protein in a feed expressed as a percentage of dry matter or this is the product obtained between total nitrogen in a feed and a factor of 6.25 i.e. total nitrogen x 6.25

Roughage. These are feeds that have high fibre content, low energy and protein usually constituting the main diet for ruminants e.g. green fodder, hay, e.t.c.

Concentrates These are feeds with a high protein and carbohydrates, low fibre, and are highly digestible e.g. ground nut cake, fish meal, molasses, cotton seed cake etc.

Protein supplements. These are feeds with a high protein content of over 30% e.g. fish meal cotton seed cake, Soya beans, etc.

Basal feed. These are feed with a high content of carbohydrates that can provide energy e.g. maize bran, rice bran, mainly cereals and wheat bran.

Bulk feeds. These are feeds that contain a limited amount of nutrients in a given weight and usually have a high fibre content e.g. forages / roughages.

Minerals. These are food stuffs found in small amounts in all feed stuffs consumed by the animals and are able to supply irons like calcium, phosphorous, sodium etc.

Examples of animal mineral sources are oyster shells, bone meal, and mineral lick.

Biological efficiency; it is the measure of the amount of out put per feed eaten by an animal. In lactating animals it can be amount of milk give per kg dairy meal consumed

Economic efficiency; it is the measure of the cost of animal products to that of inputs like feeds e.g.

$$\frac{\textbf{Output X price}}{\textbf{Feeds taken X price}}$$

Gross energy efficiency; energy output of an animal per energy intake i.e.

$$\frac{\text{Energy output in products}}{\text{Energy taken in feeds}}$$

Net energy efficiency; the measure of real energy output in products fro feeds eaten i.e.

$$\frac{\text{Energy out put in product}}{\text{Energy taken in} - \text{maintenance energy cost}}$$

Determining feed digestibility

In practice, digestibility is determined for dry matter, proteins, fats and crude fibre. Digestibility is just a proportional of food absorbed in the body less feacal nutrient. Therefore

$$\text{Digestibility} = \frac{\text{Nutrient intake (NI) - Nutrient in feaces (NF)}}{\text{Nutrient Intake (NI)}} \times 100\%$$

$$= \frac{NI - NF}{NI} \times 100\%$$

Example

A fattening animal was given a feed containing 500g of proteins and later 150g of the same protein was found in the feaces.

Calculate the digestibility of such a feed.

$$\text{Digestibility} = \frac{NI - NF}{NI} \times 100$$

$$= \frac{500 - 150}{\cancel{500}} \times \cancel{100}$$

$$= \frac{\cancel{350}}{\cancel{5}} \; \frac{70}{1}$$

$$= 70\%$$

Methods of determining feed digestibility

1. Conventional total collection

This involves giving an animal a constant daily feed intake and recording amount taken and feacal output.

2. Indicator method

In this method an inert substance is mixed with feeds and used as an indicator in determining the digestibility of a particular feed.

Characteristics of a good indicator

- It should be harmless to the animal
- It should not be digested by the animal
- It should be harmless to rumen microbes
- It should readily mix with feeds.
- It should be able to pass through the alimentary canal uniformly.

The indicators are of two types i.e. external indicators which are not part of the feed e.g. chromic oxide ad internal indicators which are part of the feed e.g. chromogens, ash etc.

Factors affecting feed digestibility

1. Difference between species.

Ruminants are more efficient in utilizing feeds than non ruminants due to their long digestive system hence will digest most of the feed taken.

2. Age of the animal

Very old and young animals have insufficient digestive systems hence show low digestibility of feeds.

3. Individual differences

Animals of the same species have shown differences in their digestibility of the same kind of feed as much as 25%.

4. Exercise

A light exercise improves digestibility of a feed while heavy exercises depress it.

5. Addition of molasses to animal feeds

These will improve digestibility of feeds since they contain highly digestible carbohydrates.

6. Type of feed.

Proteins and carbohydrates are more digestible as compared to other types of feeds.

7. Associated effect of other feeds.

Increased intake of proteins will improve digestibility of fibre.

8. Time

The whole process of digestion needs time for it to be complete hence its important to allow enough time for digestion to take place.

9. Presence of anti metabolites.

Some feeds may contain anti metabolites e.g. trypsin inhibitor in raw Soya beans.

10. Health of the animal

Sick animals will have a low digestibility of feeds due to the abnormal physiology.

RATION FORMULATION

In making any ration, the following considerations should be made:-

i. The cost of the feed

Expensive feed stuff should always be limited in this ration since they may be uneconomical.

ii. Availability of feeds.

The feeds that make up the ration should be readily available in the environment to reduce transport costs.

iii. The nutrient requirements of animals in consideration.

If the animals under consideration need a lot of proteins the ration should answer their nutrient requirements.

iv. The palatability of the feeds used.

Feeds that are used in ration formulation must be highly palatable for animals to gain from it.

v. The skills of a farmer.

The person formulating the ration should be highly skilled to produce what is required by the animal.

vi. The nature of the final product.

The ration made should be in a state that can be utilized by the animal.

vii. The age of the animals.

Animals at different ages require rations in different forms in a particular nutrient.

FORMULATIONS:

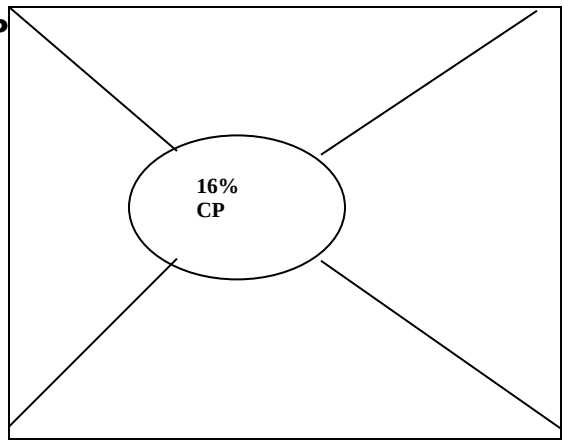
Proteins are the main criterion in determining the proportions of the ration components since they are more expensive and can't be replaced as carbohydrates.

The main method used in the person's square.

Examples

1. A dairy farmer wants to formulate a ration containing 16% of crude protein. Using maize bran which is 8% crude protein and fish meal which is 40% crude protein into 5 bags each weighing 100kgs. Show the quantity of maize bran and fish meal used.

Maize bran 8% C.P



24 parts of maize bran

Fish meal 40% C.P

08 parts of fish meal

Amount of maize bran needed in 500 kg (5 bags of 100kg@)

Maize bran $\frac{24}{32}$ x 500kgs = 375kgs

Amount of fish meal needed in 500kg

Fish meal $\frac{08}{32}$ x 500kgs = 125kgs

2. A poultry farmer wants to make a ration of 18% crude protein using maize bran which is 15% crude protein, rice bran which is 20% crude protein, cotton seed cake 30% crude protein and ground nut cake 38% to make 500kgs of Feed. Maize bran and rice bran are mixed in a ratio of **2:1** and ground nut cake mixed with cotton seed cake in a ratio of **2:1**

1. **Basal feeds**

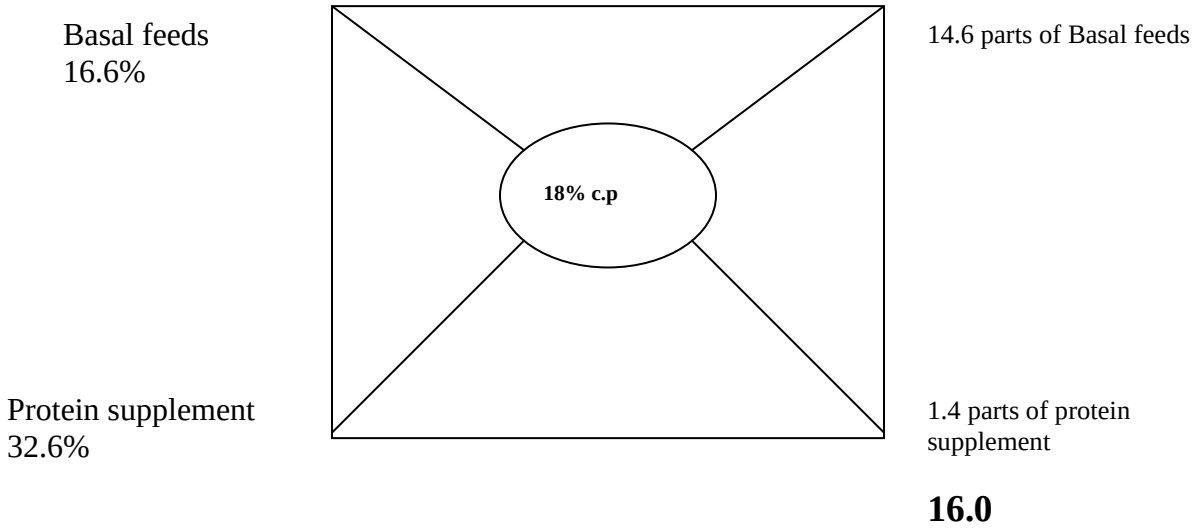
Maize bran	15% C.P	x 2	=	30
Rice bran	20% C.P	x 1	=	20
	TOTAL		**3**	**5**

50 = 16.6%
3

2. **Protein supplements**

Ground nut. Seed cake	30%	2	60
Cotton seed cake	38%	1	38
	TOTAL	**3**	**98**

98 = 32.6%
3



Basal feeds needed = 14.6 x 500 kg = **456.25kgs**
16

Protein supplement = 1.4 x 500 kg = **43.75kgs**
16

Amount of maize bran needed
2/3 X456.25= 304.2 Kg

Amount of rice bran needed
456.25 – 304.2= 152.05
Amount of G.nut cake needed

2/3 X 43.75= 29.2 Kg

Amount of Cotton seed cake needed
43.75 - 29.2 = 14.55 Kg

3. Using the following data.
Maize bran 15% C.P
Elephant grass 12% C.P
Soya bean meal 38% C.P
Fish meal 40% C.P
Formulate a ration which is 16% c.p with an allowance of 2% minerals.
N.B Minerals do not contain any protein hence cannot contribute to 16% C.P of the feed being formulated

100 – 2 = 98
Therefore $\frac{16}{98} \times 100$ = **16.3%** c.p of the final ration

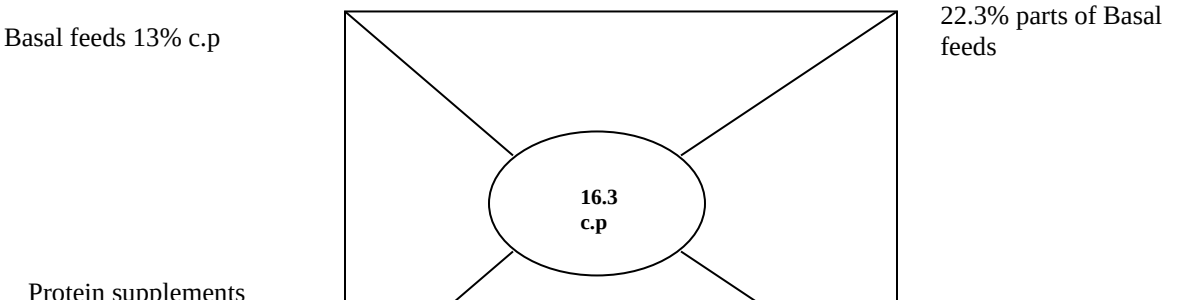
Basal feeds

Maize bran	15% c.p	1	15	39		
Elephant grass	12% c.p	2	24	3	=	**13%**
		3	**39**			

Protein Supplement

Soya bean meal	38% c.p	2	76			
Fish meal	40% c.p	1	40			
		3	**116**			

$\frac{116}{3}$ = **38.6%**



Total = 25.6

Basal feeds needed = $\frac{22.3}{25.6}$ x 98 = **85.40%**

Protein supplement = $\frac{3.3}{25.6}$ x 98 = **12.6%**

Minerals **02%**

Given the following

Wheat bran 22%C.P, cotton seed cake 35% C.P, Soya meal 38%C.P, fish meal 40% C.P

Make a ration of 18% C.P. giving an allowance of 3% minerals. Mix fish meal, Soya meal and cotton seed cake in a ratio of 3:2:1

100 – 3 = 97

$\frac{18}{97}$ x 100 = **18.5%**

Basal feeds

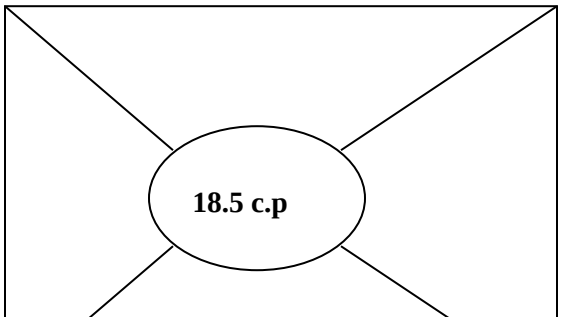
Wheat bran 22%

Protein supplement

Cotton seed cake	35%	1	35
Soya meal	38%	2	76
Fish meal	40%	3	120
		6	**231**

$\frac{\mathbf{231}}{\mathbf{6}}$ = **38.5**%

Basal feeds 22% c.p



20.0 basal feed parts

TOTAL

Basal feeds needed	$\frac{20}{23.5} \times 97 =$	**82.55 %**
Protein supplements	$\frac{3.5}{23.5} \times 97 =$	**14.44 %**

Mineral **03%**

MAJOR CLASSES OF FEEDS

There are 8 major classes of animal feeds according to Harris and Crampton. These include:-

a) Roughages and dry forage e.g. hay.
b) Pastures – These include range plants, grasses or legumes fed green.
c) Silage – This is fermented fresh grass.
d) Basal feeds or energy feeds – maize bran, rice bran, maze grains etc.
e) Protein supplement e.g. fish meal, blood meal, cotton seed cake, g/nut cake, sunflower, Soya bean meal etc.
f) Minerals – These are a good source of minerals like ca, phosphorous, cobalt, mg, zn, etc copper etc.
g) Vitamins e.g. A, B, C and B-complex
h) Additives: These are added to feeds to meet various requirement e.g. **hormones** that stimulate growth, antibodies to control disease, **drugs** to control disease, **antibiotic**s to kill pathogens, heat **synchronizing hormones**, **anti-oxidants** to control oxidation of oils in feeds and **flavourings** to improve feed flavour.

MINERALS

Importance of minerals in Animal production.

a. They are responsible for tissue irritability e.g. calcium and magnesium.
b. Some are important for the physical and chemical reactions in the body e.g magnesium that activates enzymes.
c. They are important in the clotting of blood e.g. calcium.

d. They play a structural role more especially in the skeleton e.g. calcium and phosphorous.
e. They maintain the osmotic pressure of blood and lymph fluid at the cell membrane e.g. potassium.
f. Some are important in the reproductive system e.g. Manganese which increases sex libido.
g. Some are important in the capture and harvesting of energy in the body e.g. phosphorous which is used in the combustion of Adenine diphosphate (ADP)

WATER

About 80 % of the animal's body is water. Water performs a number of functions in the bodies of animals like;

- Being part of body fluids like blood, semen, and vaginal fluids
- Gives support to body tissues
- Regulates body temperatures through evaporation to reduce heat
- Acts as a solvent for many solutes in the bodies of animals
- Acts as media for many body reactions
- Can be used in hydrolysis reactions of the body
- It's a medium of transportation of body nutrients

Sources of water for the animal's body

- Food eaten by the animal
- Water taken in directly
- Metabolic water resulting from chemical reactions
- Water stored in various forms in the animal's tissue

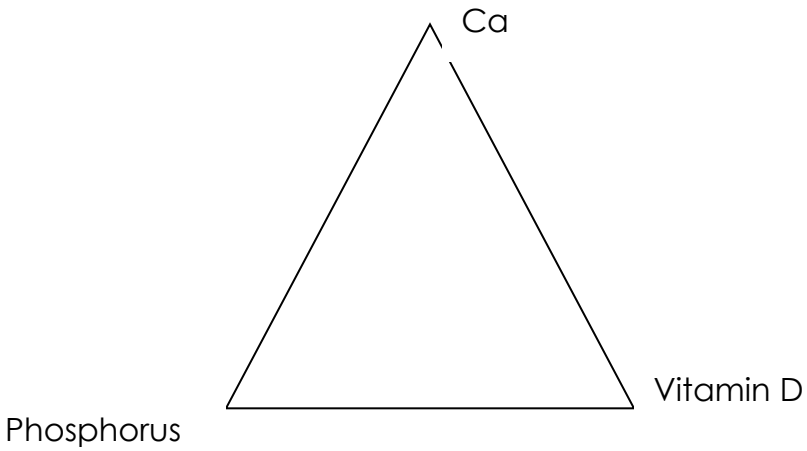
Factors that determine the level of water intake by livestock

1. **Amount of feed eaten**; animals eating a lot of feeds with less water will drink more water as compared to those eating less of such a feed.
2. **Water quality**; animals will take more of fresh water as compared to salty stinking water
3. **Availability of water**; animals drink more water once readily available at all times
4. **Increased environmental temperature;** this increases water intake as animals lose more water by evaporation
5. **Animal health**; sick animals may take less water than expected
6. **Level of animal production;** high milk yielders take a lot of water to compensate for that lost through milk secretion

7. **Type of animals;** cattle will take more water than goats due to their size
8. **Age of animals**; young animals will take less water as compared to mature animals
9. **Water temperatures;** animals will take less of cold water as compared with warm water

N.B

Some of the minerals do not function independently but in combination with others e.g. the anti rickets triangle which is made up of ca, p and vitamin D.



Classification of minerals.

Minerals are classified into two major groups i.e. micro and macro elements. The macro minerals are; ca, k, p, Na, Cl, S, Mg, etc. The micro elements are Fe, Zn, Cu, I, Co, Mn, Mo, etc.

1. Iron

This is responsible for the synthesis of haemoglobin and the red blood cells. It's also a co-enzyme in the cytochrome system. Iron is stored in the liver and spleen of animals.

Deficiency symptoms

- It leads to anaemia, however anaemia may be hereditary and also lack of Cu, Co, and proteins can cause anaemia.
- Parasitic attack can cause anaemia due to bleeding in the guts
- Iron deficiency mainly occurs in young mammals because milk is a poor source of iron and also animals kept on concrete since they have no access to soil which a good source.

2. Copper

This is essential in the synthesis of haemoglobin and also as an enzyme activator. It occurs in pigments of hair and its deficiency leads to **anaemia** and **depigementation** of hair.

3. Iodine.

This is a constituent of thyroxin responsible for regulation of metabolism in the body. Its deficiency leads to **Goiter** or enlargement of the thyroid gland.
In pigs iodine deficiency causes giving birth to piglets without hair.

N.B

Cabbage and Soya beans contain substances which prevent the secretion of thyroxin.

4. Manganese

This is an activator of most enzymes and its deficiency leads to reduced reproductive processes like spermatogenesis, reduced sex libido, and **star gazing** in chicks i.e. (chicks die with their heads facing upwards)

5. calcium

- Strengthens bones
- Helps in blood clotting
- Important in nerve transmission

Deficiency

- Weakened bones
- Low milk production in lactating animals
- Milk fever in lactating animals
- Slow growth

Lameness

6 phosphorous

- Strengthens bones
- Improves growth
- Improves fertility

Deficiency

- Poor growth
- Reduced appetite
- Poor milk yields
- Low fertility

7. Potassium

Maintains concentration of body fluids
Helps in nerve transmission

Deficiency

- Slow growth
- General weakness
- Nervous disorders

8. Salt (Sodium chloride) Na^+ and Cl^-

Used in nerve transmission

Deficiency

- Reduced appetite
- Loss of weight
- Reduced milk yield
- Death after prolonged deficiency

NUTRITIONAL AND METABOLIC DISORDERS IN LIVESTOCK

Nutrition deficiency disease may be caused by:-

i. Giving the animals too little feeds
ii. Having a diet that is low in one or more nutrients.
iii. Imbalance of nutrients provided to the animals.

1. Milk fever

2. Grass tetany

This is also called grass stagers/ hypomaganesaemia. It affects cattle and sheep mainly and it's caused by magnesium deficiency.

Symptoms:

i. Animal becomes nervous
ii. There is twitching of the muscles more especially those around the head and the neck.
iii. The head of the animal is lifted high
iv. There is accelerated respiration
v. There is increase in body temperature and gashing of the teeth.
vi. Abundant salivation which is followed by death.
vii. It occurs during the 1st week of the pasture season.

Control

i. Animals should be given mineral lick which contains magnesium sulphates, calcium and phosphorous.

3. Bloat

This is the distention of the rumen which may occur in all ruminants due to excessive gases produced by fermentation of feed stuffs.

Causes:

i. Feeding of animals on young succulent grass with high protein content.
ii. Rumen microbes interfering with normal release of gases
iii. Some animals are more susceptible to bloat than others naturally.
iv. Some plants contain compounds which tend to form lather (foam) once eaten by animals.
v. Feeding animals on feeds that are known to cause bloat.

Symptoms:

i. Extension of the rumen
ii. Difficulty in breathing
iii. Loss of appetite / animal stops to eat
iv. Death of the animal
v. Animal lies down and sticks its legs out.

Treatment:

i. Affected animal should be treated using a trocar and cannula which is used in piercing the rumen to release the gases.
ii. The animal should be given mineral oil orally to open up the system so as to allow gases out.
iii. Use of the broom stick method where a small piece of stick is laid across the mouth of the animal to keep it open and allow gaseous out.

Control / Prevention

- Feed animals in good quality forage
- Provide anti bloat drugs to animals

4. **Ketosis** (acetonemia / pregnancy toxaemia)

- A disorder of animals caused by high production exceeding feeding capacity. Occurs in high milk yielders during the first month of lactation.

Symptoms

- Low blood glucose levels (hypoglycemia)
- Rapid loss of body weight / emaciation
- Nervousness may develop in the animal
- Drop in milk yield for lactating animals
- Apparent blindness
- Walking in circles.

Cause

- Inadequate feeding for yields
- Unsuitable feeds / inadequate roughage
- Malfunctioning of the liver leading to increased keto acids in blood.

Preventions

- Adequate and proper feeding of lactating animals
- Animals should have enough green pastures.
- Animal should be exercised
- For treatment, call a vet.

ANIMAL HEALTH

Health is a situation in which all body organs and systems are normal and functioning normally or it's a state of well being where by all the vital processes of life related activities are functioning satisfactorily.

Disease is any deviation from normal health or it's a structural disorder and physiological abnormality which is harmful to the animal.

Signs of good health in animals

1. The skin of the animal is clean, smooth and shinny
2. The animal is alert and easily responds to stimuli like touch.
3. The animal has a normal appetite i.e. feeds greedily leaving no food in the trough.
4. Body temperatures should be normal i.e. 38.6^0 in cattle, 39.1^0C in goats, 39.2 in pigs and 38.9 in sheep.
5. The dung should be soft, neither excessively hard nor watery.

6. The urine should be clear pale yellow with no blood stains or bad smell.
7. The mucus membrane in the nose, mouth, eyes, and reproductive tract should be moist and pink in colour.
8. Animal production, in terms of eggs, meat and milk should be normal and consistent with the stage of production.
9. Lameness or abnormal movement is an indicator of disease.
10. Continuous coughing and sneezing is an indication of disease.

Causes of ill health in animals

1. **Heredity;**

Some diseases are transmitted through genes e.g. curved limbs in cattle.

2. **Microorganisms**;

These invade the body's animals and cause various diseases e.g. T.B. East coast fever, New castle, etc

3. **Mechanical injuries**

These can be caused by sharp objects and sometimes rough handling of the animal like beating.

4. **Nutritional imbalances**

Lack of certain nutrients in the animal's diet may cause disease e.g. lack of iron, causes anaemia.

5. **Poisoning**

Some pastures contain chemicals which can poison the animals e.g. hydrocyanic acid (HCN) found in cassava blocks respiration once taken in large amounts.

6. **Starvation**

Under fed animals in relation to their production are likely to suffer from a disease like Ketosis more especially lactating animals.

7. Exposure to extreme conditions of the environment like high temperature or very low temperatures can cause stress.

Factors that expose animals to disease (Predispose)

- **Age;** Young animals have un developed immunity while the old ones have a worn out immune system which exposes both more to disease easily.
- **Climate**; Very cold weather and humid conditions would expose the animals to respiratory infections like pneumonia.

- **Pollution**; Air and water pollution exposes the animals to many infections and may also cause poisoning.
- **Hereditary**; Inheritance of large and pendulous udders in dairy animals predisposes such animals to disease like mastitis.
- **Breed;** exotic breeds of cattle are more prone to tick borne diseases than indigenous cattle
- **Communal grazing;** this brings herds of cattle together with those that are diseased hence predisposing the health animals
- **Mechanical injuries**; these may act as entry points for the pathogens
- **Poor hygiene;** this encourages pathogens to contaminate feeds and water hence easy spread of disease
- **Improper disposal of dead animals**; animals that have died due to disease once disposed poorly may lead to easy disease outbreaks

Classification of disease

1. **Infectious disease**

This is a disease caused by living organisms like bacteria, protozoa, fungi and virus.

2. **Non-infectious disease**

This is a disease caused by something else other than living organisms' e.g. blot, milk fever, goiter, grass tetany, e.t.c.

3. **Contagious disease**

This is a disease transmitted by contact between infected animals and healthy ones e.g brucellosis.

4. **Communicable disease**

This is a disease that is transmitted from one animal to the other by both direct and indirect contact e.g. T.B, foot and mouth disease.

5. **Notifiable or reportable disease**

This is a very contagious disease, which spreads fast in herds or flocks and usually affects humans e.g. tuberculosis and anthrax.

Spread of disease on the farm / disease outbreak

1. Introduction of sick animals to the farm, which can transmit disease to the healthy ones by contact.
2. Introduction of healthy animals that are carriers of certain diseases.
3. Diseases can also spread through contaminated water and feeds.
4. Vectors like tsetse flies and ticks can also transmit disease.
5. Wild birds and rodents may carry disease to the domestic animals through contaminating feeds and water.
6. Contaminated equipment like vaccination equipment, drenching guns, insemination syringe may spread disease.
7. Shoes and clothing of any one who moves from flock to flock or in animal quarters can spread disease.
8. Airborne organisms like bacteria spores may be spread through air and cause disease.
9. Soil can Harbour resting stages for anthrax spores which can survive for up to 40 years.
10. Diseases can also be spread through infected animal products like eggs in birds can spread new castle to chicks
11. Improper disposal of dead animals that have died due to a certain disease.
12. Dung or excreta incase of cows and other young stock can also spread disease.

Control of disease

1. Farmers should make sure animal quarters are clean to keep off pathogens.
2. There should be adequate ventilation in the houses to control respiratory infections like pneumonia.
3. Ensure adequate spaces for each animal hence discourage over crowding.
4. Animals to be bought should be selected from reliable source with less risk of disease.
5. Institute quarantine measures incase of a disease outbreak in an area.
6. Practicing rotation grazing in cattle in order to control vectors like ticks.
7. The farmer should follow vaccination programmes for livestock in order to control disease.
8. Visitors to the farm should be restricted and those allowed in should be disinfected.
9. Sick animals should be isolated from the general herd or flock to reduce disease spread.

10. Dead animals should be properly disposed by either burning the carcass completely or burying it 3m deep in the soil.
11. Animals with highly infectious disease should be culled by slaughtering and burning the carcasses completely.
12. Newly bought in animals should be isolated from the general herd for Atleast 14 days to ensure that they are healthy.

QN; Explain the Cause, symptoms, mode of transmission, animal attacked and control of the following diseases.

a. Bacterial diseases

- Contagious abortion or brucellosis.
- Anthrax
- Mastitis
- Black quarter
- Foot rat
- Calf pneumonia
- Fowl typhoid.

b. Viral diseases

- Foot and Mouth Disease
- Rinder Pest
- New Castle
- Swine Fever (Hog Cholera)
- Fowl Pox
- Rabies.

c. Protozoan diseases

- Nagana (Trypanosomiasis)
- Coccidiosis
- Anaplasmosis
- East coast fever
- Red water
- Heart water

PARASITES

This is an organism that derives benefit from another (host) while inflicting pain on it.

Types of parasites

1. **Obligate parasites**

These live their entire life as parasites and cannot survive without a host e.g. the tape worms.

2. **Facultative parasite**

These can live freely in the absence of a host and as a parasite in presence of the host i.e. fleas.

3. **Endo parasites**

They live in the bodies of the host and get their nourishment from there e.g. Liver Flukes, tapeworms, round worms, gape worms etc.

4. **Ecto parasites / External**

These live on the outer surface of the host and derive their nourishment from there e.g. ticks pig lice, mites.

5. **Ecto-endo parasites**.

These live in the outer skin surface of the host e.g. jiggers and menge in pigs.

Economic importance of parasites.

1. They increase cost of production since money must be spent in trying to control parasites.
2. They make keeping of highly susceptible exotic stock very difficult e.g. ticks.
3. Some parasites are vectors of important diseases like East coast fever, Nagana red water etc
4. Some may suck a lot of blood from the animal leading to anaemia.
5. They can cause retarded growth in the host after extracting a lot of nutrients.
6. They reduce the quality of animal's products like meat, hides and skins.
7. They can cause loss of weight / emaciation/ loss of condition in the animals.
8. Some can cause open wounds to the host which may give way to other pathogens.

9. They can cause irritation to the animal leading to low production

1. TICKS.

Classification of ticks

Kingdom : **Animalia**

Phylum : **Arthropoda (jointed appendages)**

Class : **Arachinida. (4 pairs of legs) the body is divided into 2.**

Order : **Acarina**

Super family : **Oxodoidae.**

Sub families 1: **Oxodidae (hard ticks)**

Sub families 2: **Argasidae (soft ticks) mainly in chicken**

Hard ticks.

These include the following;

a. Bont tick – (***Amblyomma variegatum***)
b. Blue tick – (***Boophilus decoloratus***)
c. Brown ear tick (***Rhipicephalus appendiculatus***)
d. Red legged tick (***Rhipecephalus evertsi***)

General life cycle of ticks.

1. After matting, the female sucks blood to full engorgement.
2. It later detaches off from the host and finds a suitable protected environment on the ground where it lays the eggs.
3. Depending on temperature and humidity, the eggs would hatch into larvae at least after two weeks.
4. The larva climbs on top of grass to try and find a host.
5. After finding a host, the larva feeds for 3-4 weeks then moults into a nymph.
6. The nymph feeds for 4-6 days before moulting into an adult.

NB:

The hard ticks are classified into three distinct types according to their life cycle i.e. **one** host tick, **2** host tick and **3** host tick.

1 host tick.

- This type of tick utilizes one host for all the three instars i.e. larva, nymph and adult lifecycle.
- The larva feeds on a host until it moults into a nymph.
- The nymph feeds on the same host until it moults into an adult.
- The adults mate and take in blood up to full engorgement then drops off to the ground to lay eggs.

- After two weeks, the eggs hatch into larva and climb grass to wait for the host.
- This is the shortest life cycle covering up to three weeks. An example of such is the **blue tick** which transmits protozoa that causes **Anaplasmosis (Gall sickness)**.

2. Host tick.

- In this life cycle, the larva feeds on a different host while the nymph and adult feed on the same host or the larva and nymph feed on the same host while the adult on another.
- Larva climbs to the host, feeds on blood and after engorgement drops down to moult into a nymph.
- The nymph feeds on the same host until it moults into an adult while still there e.g. **red legged tick** that transmits **Red water (Babesiosis)**.

3 Host tick.

- In this life cycle each instar feeds on a different host and all the immature instars i.e. larva and nymph moult on the ground.
- It's the longest life cycle taking a minimum of three months.
- The larva climbs on the first host where they feed on blood up to full engorgement and later drop to the ground.
- While on the ground they moult into a nymph which climbs to another host.
- The nymph feeds on blood up to full engorgement and drops to the ground where it moults into an adult.
- The adult climbs another host and the cycle continues e.g. **brown ear tick** and **bont tick**

	Tick vector	**Agent**	**Disease caused.**
1	Brown ear tick	***Theileria parva***	East coast fever (E.C.F) (Theileriosis)
		Anaplasma marginale	Anaplasmosis.
2	Blue tick	***Anaplasma marginale***	Anaplasmosis
3	Bont tick	***Rickettisia ruminatium***	Heart water
		Theileria mutans	East coast fever
4	Red legged	. ***Babesia bigemina***	Red water

	tick		

Control of ticks:

1. Dipping and spraying animals with acaricide e.g. Dicatix, spona extra, and cooperthion. Order of spraying: Back, Brisket, Belly, rear and head.

2. Hand dressing of the animals using pye grease (yellowish jelly) on the most important parts like udder, ear, vulva, underneath the tail, in between the hooves, and around the horns.

3. Practicing rotational grazing in order to avoid areas infected with ticks.
4. Raising a perimeter fence around the farm to reduce entry of ticks into the farm
5. Old pastures in the farm should be burnt during the dry season to kill ticks.
6. A farmer can hand pick ticks from the animal more especially from small herds.
7. Pastures should be ploughed on a routine basis to burry eggs, larva and nymph.

LIVER FLUKE. (Fasciola *hepatica* and *Fasciola gigantica*)

This parasite is found in sheep, goats, cattle and occasionally in man.

Diagram of a liver fluke.

The liver fluke mainly attacks the liver and sometimes the spleen of domestic animals.
It's an hermaphrodite though cross fertilization has also been observed.

The life cycle of a liver fluke

1. Eggs are laid in the liver and carried to the alimentary canal
2. Eggs come out with the feaces and are deposited in water

3. The eggs develop into larva called miracidium.
4. The miracidium swims in water to find the intermediate host which is the water snail (*Liminaea trancatula*)
5. While in the water snail, it moults into a sporocyst.
6. The sporocyst raptures to release a new type of larva called redia while in the snail.
7. The redia migrates into digestive gland of the snail where it grows and produces the cercaria.
8. The cercaria leaves the snail and enters water where it can swim until it's taken by the animal while drinking water.
9. The cercaria while in the body of the animal can develop into adult flukes and the cycle continues.

Damage caused by the liver fluke in the liver and spleen.

1. It can make tunnels in the liver and spleen hindering their functions.
2. They can block the bile duct hence affecting digestion of fats in the animal.
3. It makes the liver unsuitable for human consumption.
4. It causes death of tissue in the liver and spleen.

Characteristics of animals having liver fluke (symptoms).

1. Swellings under the jaws.
2. Death of the animals without prior signs.
3. Emaciation / loss of weight / loss of condition.
4. The mucus membrane turns yellow.
5. Passing out of watery feaces / diarrhea.
6. General weakness of the animal.
7. Coughing and sneezing.
8. Reduction in milk production for lactating animals.
9. Reduced growth rate in young animals.

Control of liver fluke

1. Practice rotation grazing by keeping animals away from swamps more especially on rainy seasons.
2. Remove the grass and any vegetation from water points where the cercaria can attach itself.
3. Animals should be given water from bore holes or fast moving water from rivers with no snails.
4. Spray copper Sulphate in the grazing area to kill the water snail.
5. Pastures in swampy places should be burnt during the dry season to kill the snails.

6. Animals should never be grazed in flooded areas that are likely to have snails.
7. Swampy places should be drained so that excess water is removed to discouraged water snails.
8. Routine deworming of the animals using drugs like levafas, endospec 10% every after two months.
9. As a biological control, farmers can rare ducks which feed on the snails.

WORMS:

Livestock is attacked by internal worms, tape worm, gape worms. The most common are the round worms and tapeworms which attack cattle, sheep, goats, pigs and man.

Signs and symptoms of internal worm attack in livestock

1. Rough hair coat/ standing hair.
2. Stunted growth in young animals.
3. Emaciation / loss of weight / loss of condition.
4. Diarrhea.
5. Loss of appetite.
6. Pot belly / extended belly.
7. Worms or segments of the worms or eggs can be seen in feaces.
8. Coughing by the animal which can be occasional.

Adaptations of gut worms to their mode of life.

1. Degeneration or loss of unwanted organs and structures like eyes, legs and ears.
2. They have penetrative devices for gaining entrance into the host and attaching themselves in the gut walls so that they cannot be dislodged
3. Presence of sacking devices like in the tape worm which helps in sucking nutrients.
4. Possession of hard cuticle which can resist the host's digestive enzymes.
5. Production of large quantities of mucus against the host's digestive enzymes.
6. They have more than one host which increases their chance of survival.
7. Production of a large number of eggs to increase their survival chances.
8. Possession of muscular pharynx in round worms for sucking nutrients from the host.
9. Most gut parasites are able to tolerate low levels of oxygen common in their environment.

10. Some are hermaphrodites like the tape warm which increases the chance of survival by ensuring fertilization and reproduction.

11. A large surface area has been observed in the tape worm and liver flukes which increases diffusion of oxygen and nutrients.

12. The eggs of most of these worms are covered by a thick cuticle which helps them to resist harsh conditions of the environment before hatching.

Round worm	**Tape worm**
Scolex absent	Scolex present
Short in length and small	Long and big
Round	flat
No segments	Segmented
No suckers	Has suckers
Tapering ends	Has no tapering end
Has no hooks	Has hooks

Life cycle of a tape worm

a. Adult tape worm in the intestines of man lays fertilized eggs
b. Eggs are passed out with feaces
c. Eggs develop into oncosphere which are eaten by grazing pigs or cattle
d. Each oncosphere contains six hooked embryo called hexacanth
e. The wall surrounding the hexacanth is digested in the duodenum to release bladder worms
f. The bladder worms bore through the walls of the intestines and enter blood or lymphatic system

g. They are taken to the voluntary muscles of the tongue and limbs
h. Badly cooked meat eaten by man the bladder worm is eaten
i. The bladder worm attaches it self on the walls of the intestines and develops into a tape worm

DIGESTION IN RUMINANTS

1. Mouth

Food is gathered here with the help of tongue and teeth, a process referred to as prehesion.

There is also chewing of food (mastication) and mixing it with saliva (salivation). Chewing of the curd also takes place here.

N.B. The saliva of ruminant animals does not contain any enzyme, but its work is to lubricate the bolus and facilitate passage through the oesophagus.

2. Oesophagus

This is a passage for the bolus from the mouth to the rumen

Rough materials that escaped thorough grinding during preliminary mastication pass back to the mouth through oesophagus.

It allows gases to escape from the rumen to the out in the process of belching.

3. Rumen / pouch

It has a surface with projections like a towel

It acts as a store for food.

It refines the food particles.

It churns and mixes the food thoroughly with the rumen liquids.

Coarse food particles are directed to the mouth for further chewing.

Provides place for fermentation by microbes like bacteria, fungi and protozoa.

4. Reticulum

Its known to have a honey comb structure surface

Regulates passage of food from the rumen to the Omasum and from the rumen to aesophogus.

It allows fine food to enter the Omasum

It stores heavy materials like stone, stick, wire swallowed with food that why its referred to as the hard wave stomach.

5. Omasum

It has a surface with flaps that resembles papers of a book.

Most water and organic acids are absorbed here.

Solid particles left in food are further ground by the muscular leaves of the Omasum.

The leaves form a pumping action that causes food into the abomasum.

6. Abomasum (true stomach)

It has a smooth surface

The walls secrete Hydrochloric acid and gastric juice .

Gastric juice contains enzymes rennin and pepsin which digests proteins.

Rennin curdles milk in young mammals.

7. Small intestines.

Digestion is completed here by the pancreatic enzymes like lipase, amylase, trypsin, maltase and sucrase.

8. Large intestines

It is where the absorption of water takes place.

Conditions that favour rumen microbes.

1. The pH ranging between 6.2 – 6.7 which is maintained by saliva and continuous removal of volatile fatty acids (ethanoic acid (acetic acid), propionic acid and butyric acid)
2. Low levels of oxygen since most of the microbes can respire anaerobically.
3. The temperature of about 39^0c in the rumen.
4. Enough moisture from water drunk, animal feeds and saliva.
5. Presence of macro minerals and some trace minerals in the rumen needed by microbes.
6. Regular removal of digested material so that fresh materials are in contact with the microbes.
7. Presence of readily fermentable carbohydrates like glucose, sugars and starch in feeds eaten.
8. Adequate supply of energy and nitrogen which enhances microbial activities

Importance of microbes in ruminant alimentary canal.

1. They enable ruminants to utilize fibrous material by hydrolyzing cellulose into monosaccharide.
2. They build up complete proteins from elementary nitrogen which can be used by the host animal.
3. They can upgrade dietary protein to a standard needed by the host animal.
4. They can synthesize vitamins K, B, C and B complex for the host animal.
5. At death, they provide proteins to the host animal.

Factors affecting feed intake by the animal.

1. Environmental temperature; high environmental temperatures reduce feed intake while low environmental temperature stimulate feed intake.
2. Palatability of the feed; feeds that are highly palatable would be consumed in large quantities by the animals as compared with unpalatable feeds.
3. Blood components; a high quantity of glucose and volatile fatty acids in the blood of ruminants will suppress feed intake.
4. High lignin content in feeds will suppress feed intake since it has a low digestibility.
5. Shift in hormonal balance; during pregnancy, feotal displacements of the rumen and reticulum and changes in hormones will affect food intake.
6. The volume of the alimentary canal; when the alimentary canal is filled with feeds fast it will cause distention in the reticulo- rumen restricting further feed intake.

7. Level of animal production; animals that produce a lot of milk will eat more feeds to compensate the loss in milk.
8. Animal health; sick animals will take less feeds as compared with the health ones
9. Amount of feed provided; animals will always strive to eat all what is provided hence giving a lot of feeds increases intake

Improving digestibility of feeds.

1. Selecting animals with high digestibility naturally.
2. Providing feeds with high nutrients value to animals.
3. Avoid excessive exposure of feeds to rain and sunshine in order to maintain their quality.
4. Avoid prolonged exposure of animals to harsh weather conditions by providing a shade.
5. Provide ample salt and plenty of fresh water for the animals.
6. Add molasses to feeds to improve digestibility.
7. chop pasture and crush feeds to increase surface area for enzymatic action

Carbohydrate digestion in ruminants

a) Ruminants do not have salivary amylase therefore the first enzymes to act on carbohydrates are in the rumen
b) Enzymes in the rumen for carbohydrates are produced by the microbes
c) Microbial amylase and cellulase breaks down starch and cellulose respectively
d) The end products for carbohydrate digestion in the rumen are volatile fatty acids (VFAs-**acetic/ ethanoic acid, propionic acid and butyric acid**), methane and carbondioxide. Formic and lactic acids are produced in small amounts.
e) The amount of acetic acid produced depends on the amount of fibre and starch in the diet. A diet with high fibre results in production of more acetic acid while consumption of high starch results into production of more propionic and butyric acids.
f) VFAs are absorbed and utilized for energy production rather than glucose used in non ruminants
g) Acetic acid is the main source of energy in ruminants.

Nitrogen conservation mechanism in ruminants

a) Digestion of coarse fodder in ruminants depends on the activity of micro organisms in the rumen.
b) The micro organisms require supply of energy and nitrogen for their growth and multiplication. In return micro organisms brake down cellulose
c) Nitrogen is very important in ruminant digestion since it can be used by rumen microbes and in the building up of ruminant protein. Therefore, it must be conserved

It is conserved in the following ways;

i. Ammonia absorbed from the rumen plus that arising from tissue metabolism is converted to urea.
ii. In non ruminants, urea would be lost in urine but in ruminants, it is recycled back to the rumen through salivary secretion and across the rumen wall.
iii. The recycled urea is utilized by the rumen microbes to build up proteins for the host animal.
iv. The proportion of urea to nitrogen recycled depends on the quantity of nitrogen in the diet
v. Low dietary nitrogen causes more nitrogen from the liver being returned to the rumen to build protein
vi. The cycle ensures continuous source of nitrogen for rumen digestion.

AGRICULTURE ECONOMICS

This is the best to produce crops and animals maximum returns use of scarce resources.

Production

It's the creation of goods and services in order to satisfy man's needs.

Factors of production

This is an aggregate of free gifts of nature, human capacity and all sorts of man made aides that help in production. The factors of production include; land, labour, capital, interpreneourship.

LAND

Anything provided by nature under or over the earth's surface. Land can lead to development in several ways:-

1. Its where buildings are constructed.
2. It's a source of minerals
3. It provides soil used in agriculture for crop growing
4. It can provide fuel in form of fire wood.
5. It's a source of all raw materials used in production
6. It can be taxed to provide revenue for the government
7. It can be mortgaged for loans.

Land tenure

These are rules and conditions governing the ownership of land in a specific area.

Forms of land tenure

1. Private ownership / free hold/ land lordship/ individual ownership.
2. State ownership
3. Communal ownership
4. Lease hold
5. Co-operative land tenure.

Private land ownership

This is where an individual puts action on a piece of land as his personal property by getting a title deed after registering it with government.

Advantages

1. Land owner can mortgage the land for a loan since he has a title deed.
2. The owner can use the land the way he likes for developed.
3. Land consolidation and planning becomes easy since what is owned by the farmer is known including the value.
4. It avoids land disputes since the land is well demarcated.
5. It acts as an incentive to farmers to improve the land.
6. The land owner can sell the land or part of it easily incase of financial constraints.
7. It safeguards against the position of the local community if land is in short supply.

Disadvantages

Tenants can easily be made hand less when the owner sels the land in their absence.

It encourages of Harding of land incase of absentee of land lord.

It may lead to political upraising against land lords who have tough rules on land usage.

State ownership

This is where land belongs to the state and no individual has control over it. People can be evacuated anytime without compensation when government wants to use the land.

Advantages:

1. It allows fast decision making in the use of land by the state.
2. It encourages large investments on land by government like plantations, factories etc.
3. Government can run out land to raise revenue for development

Disadvantages

1. People have no security over the land occupied since they can be evacuated any time.
2. Government can fail to utilize the land efficiently by awarding it to political allies.
3. It can be a source of political on-rest when people are sent away from government land.

Communal ownership

This is where land is owned by the community as opposed to individuals.

x-teristics of communal land ownership

1. Its common in the pastoral communities of East Africa
2. Land is neither bought or sold.
3. Every member of the community has a right to use land
4. Land is allocated to individuals by clan leaders or village elders.

Advantages

1. Every member of the community has access to land irrespective of his social and economic background.
2. There is efficient use of land since abandoned land can be given to members of the community.
3. Each person can cultivate or graze on the communal land with no restriction.
4. There are no cases of landlessness.

Disadvantages

1. It doesn't give any incentives for improvement of land by the farmer.

2. There is a tendency of over stocking and over grazing leading to erosion.
3. Its difficult for a farmer to use the land to get a loan since he has no title deed.
4. Increasing population leads to land fragmentation since children have to share their fathers' land at death.
5. Continuous cropping may lead to destruction of soil structure.
6. Its difficult to improve livestock since controlled breeding is hard to practice on such land.
7. Pest and disease control is very difficult since farmers are difficult to mobilize under such a system.

Lease hold

Here land is given to the tenant by the state or the landlord for a specific period of time like 49years and 999years.

Advantages

1. The tenant has security of tenure
2. The tenant can use the title secured to acquire a loan for development.
3. The tenant can rent out the land to get extra income.
4. It minimizes land disputes because of proper land demarcation
5. It encourages the growing of perennial crops.
6. The tenant is encouraged to carryout land conservation measures.

Disadvantages

They are the same as private ownership.

Co-operative land tenure

This is where land is owned by individuals who organize themselves into a co-operative.

Advantages

1. The land is used efficiently for productive purposes.
2. The co-operative organisation can use the land as security to acquire a loan
3. Group ownership of land is a source of security.
4. There is collective work on the land which leads to high production.
5. Members can share profits and losses that are made.

Disadvantages

1. Individuals cannot easily get loans for production
2. Decision making is difficult as far as usage of land is concerned.

LAND REFORMS

This is an organized action designed to improve the structure of land tenure and land use.

Examples of land reform

1. Land consolidation
2. Land registration
3. Land re-distribution
4. Settlement and resettlement schemes.

Objectives of land reform

1. Achieving high levels of output through security, incentives and investments.
2. Achieving flexibility of farming patterns to meet changing natural market demand.
3. Increasing productivity of both land and labour.
4. Achieving effective utilization of national land resources which can include settlement of people on an used land and introduction of irrigation.
5. Encouraging production from the market as opposed to subsistence
6. Encouraging conservation and improvement of land.

Settlement and resettlement skills

Reasons for setting up

1. To ease population pressure by removing people from highly populated places to those with sparced population.
2. To prevent pest and disease attack e.g removing people from places infested with tsetse flies.
3. increase land for agricultural production by removing less productive people from the land.
4. To facilitate mechanization of availing more land to the people.
5. To settle the land less people who may become a problem within the population.
6. To resettle displaced people who might have been displaced by natural calamities and political insures.
7. To encourage self employment to people after being given land.
8. To resettle unemployed people so as to reduce rural-urban migration.
9. To carryout research in agriculture activities in resettlement schemes.
10. Train youth in improved methods of farming so as to improve their welfare.

Land registration

This is where a farmer comes to an agreement wit government over the ownership and use of land through the acquisition of land title deed.

Importance:

1. The land owner has security of tenure hence can develop the land.
2. He can use the land tilte to obtain loans.
3. Land owner can easily rent out land to get extra income.
4. It minimizes land disputes because of proper land demarcation
5. It encourages land development through establishment of perennial crops
6. Land owner is encouraged to carryout soil conservation measures in order to protect his land.
7. It is easy to sale or transfer the ownership of land.

Land consolidation

This is the pooling of small pieces of land to form a large and more productive land when put together.

Steps in land consolidation

1. Establish land ownership
2. Measurement of the plot to be consolidated in order to establish their size.
3. Describing the nature of the fragment
4. Valuing the fragments to be consolidated
5. Recording each fragment of land for further consideration
6. issuing of the title for the consolidated land or fragments.

Advantages

1. Saves time that could have been wasted moving from plot to plot during farm operations.
2. Makes supervision of farm operations easy and less costly since they are in one place.
3. It encourages mechanization on a farm since the land is big enough which makes the practice economical.
4. Agricultural production is increased due to the size of the land.
5. Its easier to provide extension services on the consolidated land.
6. Thefty of farm produce is reduced due to improved supervision.
7. Transport costs of the produce from the garden is reduced since all products are in oneplace.
8. Its easier to control pests and diseases on the farm.
9. Its easier to carry out soil and water conservation measures.

Disadvantages

1. It may make people land less.
2. It may cause political unrest among the population

3. It's a very costly exercise since each fragment is of a different value.

LAND FRAGMENTATION

This is where agricultural farm land is split into small plots of different places belonging to one farmer.

Causes of land fragmentation

1. An increasing population in the country making land to be scarce
2. Traditional system of land inheritance wher sons share the fathers' land upon his death.
3. Limited income among the farmers which forces them to buy small affordable plots.
4. Farming systems like shifting cultivation which allows farmers to move from place to place.

Effects of land fragmentation

1. Its difficult to supervise all plots effectively.
2. A lot of time is wasted in moving from plot to plot.
3. farm planning is difficult due to the small size of the fragments.
4. It encourages low agriculture production.
5. Thefty of farm produce is common due to reduced supervision.
6. Agricultural mechanization is difficult due to the small size of the plots which are scattered.
7. Its difficult to offer agricultural extension services on such scattered plots.
8. Its difficult to carry out soil conservation measures due to the distance involved.
9. Pest and disease control on the fragments is difficult.
10. Its difficult to control grazing since farmers have small plots that are prone to overstocking and overgrazing.

CAPITAL

It's a stock of assets which are meant for the production of other assets.

Types of capital

1. Fixed capital / Real capital

This includes land, building, fences, machines, tools, livestock and crops in the garden.

2. Working capital

This is money or materials used in day to day running of the farm business e.g fertilizers, fuel, seed etc.

3. Private capital

These are assets owned by individuals

4. Social capital

These are assets that are owned by the state on behalf of the citizens e.g roads, schools, hospitals, gov't farms etc.

AGRICULTURE CREDIT

This is money or resources which farmers borrow from various institutions of individuals to improve their production and development.

Importance of agriculture credit.

1. It allows farmers to finance profitable activities from the farm.
2. It encourages the farmer to develop a sense of saving.
3. It increases capital development on the farm in form of buildings, fences etc.
4. It allows a farmer to finance big investments beyond his incomes.
5. It encourages better farming techniques in agriculture
6. It can lead to improvement of the standard of living amongst farmers.

Sources of agriculture credit.

1. Commercial banks like stanbic, DFCU
2. Co-operative organizations e.g
3. individual money lenders
4. farmers organizations i.e Uganda National Farmers Organisation (UNAFA)
5. International bodies like International Fund for Agriculture Development, Food and Agriculture Development, International Monitory fund.
6. Development banks like UDB, EDB.
7. Marketing board, Uganda Tea Board, Central Bank of Uganda.

MEASURES THAT ENSURE EFFECTIVENESS OF AGRIC CREDIT

1. Provision of extension services / education to farmers on how to use loans.
2. Improvement of loan supervision to ensure prompt payment.
3. Improving loan recovery programme by encouraging part repayment over a period of time.
4. Improving staff training for effective co-ordination with farmers.
5. Provide farmers with inputs at fair prices for easy repayment.
6. Provide farmers with loans in kinds like fertilizers, pesticides, improved seeds etc.
7. Organise marketing of farmers produce at fair prices.
8. Give loans to farmers in time or at the correct time to reduce risks.
9. Give adequate grace period to allow loan payment to take place easily.
10. Charge fair interest rates that can be met by the farmers.
11. Help farmers to identify viable projects for investment.

PROBLEMS ASSOCIATED WITH LOAN REPAYMENT

1. High interest rates which may be difficult to be met by a farmer to pay during loan repayment.
2. Short grace period which doesn't allow the farmer to realize the borrowed money.
3. Risks and uncertainties that cause severe cases.
4. Poor loan supervision among the loan providers giving room for defection.
5. Credit unworthyness of some farmers who may not want to pay back the loan.
6. Death of the farmer living no body to pay the loan.
7. Political interference where a farmer may take the loan advanced to be a political payment or reward.
8. Inadequate knowledge of a farmer on how to use loans effectively

Types of agricultural credit.

LABOUR

This is human effort both manual and intellectual directed towards the process of production.

Classification of labour

Labour can be classified as;

a) Skilled labour.

This is where people perform jobs in which they have training i.e teacher teaching, doctor treating

b) Semiskilled.

This is where a person performs a particular job where he has no training but has some knowledge about it.

c) Unskilled labour

This is labour provided by people who are not trained at all in such a field.

d) Family labour

This is labour provided by family members like children wives, in agriculture work.

Efficiency of labour

This is the measure of out put per person per hour / time

Its affected by

1. Education / training, easier ways of doing work.
2. Health
3. Incentives i.e. attractions to work e.g. salary.
4. Climatical conditions
5. Supervision
6. Organizations of people for work.

LABOUR FORCE

This refers to economically active people between 15-65yrs of age excluding students, house wives and disabled.

Labour supply.

This is the number of hours worked / period of time.

Factors affecting labour supply.

1. Health conditions of the workers.
2. Motivation in terms of salaries and allowances.
3. Working conditions.
4. Population size a high population leads to provision of labour e.g china
5. Retirement age, a high retirement age guarantees a high labour supply.
6. Immigration and emigration (increases labour)
7. Labour mobility, a high labour mobility leads to high labour.

8. Working time, as number of working time increases supply of labour also increases.
9. Strength of trade unions. These can reduce the number of people employed to maintain the wedge by fixing a high minimum wedge.

Labour mobility

This is the ease with which labour can move from one place to another (geographical mobility) or from one job to another (occupation mobility)

Factors affecting labour mobility

1. Limitations in skills e.g its hard for a sweeper to do doctors work.
2. Time required for training, along training period reduces the rate at which such people can join that occupation.
3. Rabal differences in some countries certain jobs are reserved for a particular race.
4. Trade unions, workers can we collective effort to burgain for higher wedges and reduce entry of others in employment.
5. Transport, poor transport resists movement of people from place to place.
6. Security, poor security can affect the acquisition of jobs in particular areas.

MANAGEMENT / ENTREPRENEURSHIP

An entrepreneur is a person who undertakes the task and risk of organizing other factors of production so as to earn profits. The reward for the entrepreneur is profit or loss depending on performance of the business.

Methods of increasing profits in Agriculture

1. choosing correct business with less risks and uncertainties
2. selling produce when prices are high i.e having good storage facilities
3. timely planting of crops so as to benefit from the high prices that are offered at the beginning of the harvesting season.
4. Use of better techniques of production i.e improved seeds, good breeds.
5. Processing agriculture products so as to add value hence more profits.
6. Advertising your produce so that buyers are aware
7. Grading the produce to allow fair prices for each product.
8. Parking of the produce so as to reduce transport costs and increase the profit margin.
9. Proper control of pests and diseases i.e increase quality.

10. Proper allocation of resources to avoid over spending and under spending.

COSTS OF PRODUCTION

1. Fixed costs / overhead costs / unavoidable costs.

These are expenses that a farmer has to meet whether in production or not. They include;

Interest on loans, rent, depreciation, salaries for permanent workers.

2. Variable costs / prime costs.\

These are expenses that depend on the level of output or varry with out put e.g costs for inputs (pests, seeds) wedges for casual workers increase in output increases the variable costs.

3. Implicit cost.

These are expenses that are indirect or non eacho costs of owned resources e.g own labour, family labour etc. They are va;ued using their opportunity cost.

N.B. They are not included in the calculations of profits of the farm of accounting.

4. Explicit costs

These are direct costs paid for resources / bought or hired.

5. Opportunity cost

this is a cost for the best alternative foregone in making a decision e.g if a farmer foregoes poultry farming and takes on dairy then the opportunity cost is that one for poultry.

6. Total valuable cost (TVC)

this is the total of the cost of all valuable resources used in production (price x quantity)

7. Total fixed cost

This is the value of all the indirect cost of fixed resources used in production. Its constant at all levels of output.

8. Total costs

It's the sum pf all the fixed and variable costs at each level of output i.e total cost will = total variable cost + total fixed cost.

9. Average variable cost

It's the amount spent on variable inputs per unit of output.

i.e AVC = $\frac{TVC}{Y \text{ (Out put)}}$

10. Average fixed cost.

It's the cost of the fixed resources per unit of output.

AFC = $\frac{TFC}{Y \text{ (Out put)}}$

11. Average total cost

It's the total cost of all resources (Fixed and variable) per unit of out put

i.e ATC = $\frac{AVC + AFC}{Y(\text{ Out put})}$

12. Marginal cost

This is the change in total cost resulting from a change in one unit of output i.e its the cost of producing an additional unit of output.

13. Marginal product.

This is output created by using one additional unit of a factor of production.

14. Cost output relationships

Production function

This is a mathematical relationship between input and output

1. Total product, TP

This refers to the total output resulting from all the factors of production (both fixed and variable)

2. Average product AP

This is the output per unit of a variable factors. An example of r/s between out put and inputs.

Fixed factors (land)	Quantity of fertilizers used (input)x	Total maize TP output (Kg) Y	Marginal product (MP)	Average product (AP)
1	1	8	0	8
	2	18	10	9
	3	30	12	10
1	4	38	8	9.5
1	5	44	6	8.8
1	6	48	4	8
1	7	48	0	6.9
1	8	46	-2	5.7
1	9	42	-4	5.5

Stage 1: Irrational stage / increasing returns

- Production is not yet maximum
- Increase in variable input increases output.
- Most farmers in Uganda operate at this stage since they have little knowledge about maximization of profits or lack capital.
- This relationship doesnot continue for long because the soil becomes over saturated with fertilisers causing harmful effects.

Stage 2: Decreasing returns / rational stage

- The total product increases but at a decreasing rate
- Marginal product decreases until it reaches zero at the end of the region.
- A farmer operating in this region with proper advise from qualified staff would benefit much.
- This type of production function is the most common type in agriculture production.

Stage 3: Region of re-returns

- It starts when marginal product is zero
- Its an irrational region and this situation can arise as a result of using too much fertilizers.
- Advice is that the farmer should not over use variable inputs but seek advise from extension staff.

Recommendations about input use

- More imports must be added until stage 2 is reached because the physical efficiency measured by average products increases throughout stage 1.
- Even if the inputs is free, it should not be used in stage 3

Law of diminishing returns:

As you add more and more successive units of a variable factor to a fixed factor while holding other factors constant (ceterio parlbus) total production increases but beyond a certain point (point inflection / bliss point) the resulting increase will become smaller and smaller.

RISKS AND UNCERTAINITIES

A risk is an avoidable and unforeseeable circumstance hazard that affects the outcome of an investment and can be measured in an empirical and quantitative manner. Since the risks are measurable, they can be insured against.

Uncertainty, this is unforeseeable and unavoidable circumstances or hazard that affects the outcome of an investment but cannot be measured in an empirical and quantitative manner hence cannot be insured against.

Examples of risks

1. Change in weather or bad weather which cause destruction to crops, building and animals.
2. Pest and diseases.
   This can cause losses in both plants and animals.

3. Fire outbreak
   This can blestmultine to property and life.
4. Theft

This can be of farm produce and machinery yet its hard to predict when it will happen.

5. Strikes of workers.
   Some of the strikes are very destructive and lead to loss of property and life at the extreme cases.
6. Ill health
   The farmer, members of his family, all the workers can fall sick which can greatly affect the production level of the farm.
7. Low crop yields.
   This may be caused by many factors like poor soils, natural hazards, pests and diseases, poor management etc.
8. Death of the farmer.

Guarding against risks.

1. Insurance.
   This is the most common method of guarding against risks where the farmer insures his property with an insurance company against risks.
2. Building owners equity.
   This is where a farmer saves some money that can be used incase there is a risk (networth)
3. Input rationing.
   Here a farmer uses less than optimum quantities of inputs to save on the amount spent on input.
   Improving storage facilities i.e one can lead produce and sale later
4. Choosing and interprice with less or limited risks hence helping a farmer easily escape risks.
5. Diversification.
   This is where a farmer engages in more than one enterprise so that incase one fails the other may succeed and compensate the loss made.
6. Production flexibility
   This is where a farmer invests inflexible enterprises that easily allow a change e.g keeping duo purpose breeds of cattle and poultry.

UNCERTAINTIES

Examples

1. Price fluctuations
   Its very difficult to know when the prices will fluctuate and the loss which will come out of this is extremely difficult to calculate .

2. Change in demand.
   The demand for agricultural products keep on changing yet the loss as a result of this is difficult to measure.

3. Change in technology.
   Because of rapid technological changes, machinery and farm techniques quickly become ottdated.

4. Change in government policies.
   The government may reduce prices of commodities by covering taxes and viseversa.

5. Bleach of contract
   This can happen anytime without notice and may cause unmeasurable loss depending on the commodities.

6. Unavailability of labour.
   This may happen during planting and harvesting time yet the losses in causes its unmeasurable. This change in labour supply is due to a number of factors affecting it.

7. Unavailability of agriculture inputs.
   The supply of such inputs is affected by a number of factors therefore their scarcity once experienced can cause uncertainty.

Control of uncertainties

1. producing on contract
2. building owners equity
3. diversification
4. input rationing i.e price fluctuation.
5. flexibility i.e easily change from type of production to another
6. improving storage facilities.
7. adding value of agriculture products through processing.

SPECIALIZATION

This is where one engages in the production of one item where he can feature best.

Forms of specialization

1. Specialization by craft

This is where families specialize in different activities like farming, iron smith, witch craft etc.

2. Specialization by process

This is where every stage of production in a factory or an industry is carried out by a different person.

3. Regional specialization

This is where each region produces the best it can and the changes it with what it can't produce.

4. International Specialization

This is where each country produces what it can do best and exchanges it with what is produced by other countries.

Advantages of specialization

1. Its time saving

There is no wastage of time in moving from job to job or training for different jobs.

5. High efficiency in production since the workers gain a lot of experience and skills in doing one type of work.

6. It enables the farmers to exploit their natural talents by concentrating on the work they can do best.

7. It encourages the use of machines at various production levels.

8. Regional and international specialization enables countries to exploit their natural resources and get what they cannot produce.

9. It encourages farms to employ specialists at different stages of production leading to efficiency.

10. It increases production which helps farmers to gain from the economy scale.

Disadvantages

1. Large scale production may be limited by a low market for the produce.
2. It may lead to unemployment incase of change in technology and fashion.

3. It may lead to over dependence incase of international specialization
4. It may lead to boredom to repetition of the same work.
5. It encourages the use of specialized machines which cannot serve more-than one purpose.
6. It encourages loss of craftsmanship since workers depend on machines to do the work.

DIVERSIFICATION

In Agriculture, diversification is the raising of the variety of crops or animals as opposed to one enterprise.

Advantages

1. Resources are effectively utilized in the production process
2. It reduces risks that are associated in producing one type of crop or animal.
3. It increases a variety of products produced in a country.
4. It encourages the participation of many people in the production process to produce the different goods.
5. It reduces over dependence on products from one place or country.

Disadvantages

1. The practice is limited by inadequate capital to engage in different enterprises.
2. Limited market for a variety of products may affect diversification
3. Limited farm implements may discourage diversification
4. Its very difficult to carry out research on a variety of crops and animals to increase their production.
5. Climate may not favour the production of various products.
6. It encourages subsistence farming which is less profitable.

CO-OPERATIVES

This is a registered organisation of people who decide to work together for mutual economic benefits.

Types of co-operatives:

1. Transport co-operatives

These deal with the transport of produce either for the members or for profit from other organizations e.g Uganda Co-operative transport union.

2. Credit savings co-operatives.

These deal with savings of members money and provision of small loans e.g Uganda Women Credit and trust fund.

3. Consumer Co-operative

These stock and sell commodities to members at subsidized prices and can also give financial assistance to members.

4. Producer co-operatives.

These are concerned with the marketing of the farmer /members produce e.g Busoga growers co-operative union, Masaka co-operative union.

5. Trade and craft co-operatives.

These are mainly concerned with building and construction work.

Principles of co—operatives

These are the basic guidelines which the formation and day to day running of co-operatives is based.

1. Open and voluntary membership.

All people are free to join or leave the co-operative without hindrance or restriction of any kind.

2. Democracy

Co-operatives are run on democratic principles even when elections are half for the leaders i.e one man one vote.

3. Interest and profit.

The rate of return on borrowed capital should be low since the organisation is not a profit making one.

4. Capital shares

The financial capital for co-operatives is raised through the selling of shares to the members.

5. Co-operation

Co-operatives must work together with other co-operative organisatons in order to learn from each other.

6. Neutrality

Co-operatives must be neutral in politics religion or any other bias that can affect their operation.

7. Promotion of members

All promotions to places of high responsibility must be based on merit.

8. Education

Co-operatives must promote education for their members inorder to reduce the rate of illiteracy and also increase the skills needed in running of the co-operative.

9. Continuous expansion

A co-operative must have a continuous expansion in terms of members and physical facilities i.e building machinery.

10. Share of dividends

There is share of dividends after calculating how much a members has contributed to the co-operatives.

11. co-operatives can mobilize prices for agricultural products by buying produce during supply and selling it at times o scarcity.
12. They can increase investments for the members by buying buildings, estates, factories on behalf of the co-operators.
13. They eliminate wasteful competition and exploitation of farmers by middle men hence increasing the farmers profit margins.

14. They increase the bargaining power of members in the market and protect the weak ones.

Problems of co-operatives

1. Inadequate skills of management amongst farmers which makes them incompetent in organizing co-operatives.

2. Inadequate funds to finance the work for co-operatives which limit the investments and expansion of the co-operatives.

3. Embezzlement and corruption by managers has reduced the growth of most co-operatives in Uganda.

4. Inadequate transport.

Some co-operatives do not have tracks that can easily transport produce to places where there is enough market.

5. Shortage of storage facilities

Most co-operatives in rural areas do not have enough stores with facilities like freezers that can help in storing produce.

6. Fluctuating prices for agriculture produce.

The fluctuation in prices more especially at the world market has affected the income for co-operatives hence their operators hindered.

7. High risks and uncertainties in agriculture.

These reduce the profit margin fore co-operatives which greatly discourages the farmers.

8. Political interference

Some politicians in government have influenced the decision in co-operatives which greatly affects their performance.

9. Political Instabilities

In places where there is insurgency its been very difficult for co-operatives to operate.

10. Dishonesty of members who refuse o pay back the loans or sale their produce to other co-operatives.

11. A high competition for private sector which has affected the amounts of profits that can be made.

Solutions

1. more centres for training managers should be set up to equip managers with skills.
2. co-operative should access loans from banks and other lending institutions incase of lack of funds.
3. constant auditing should be done so that the managers are made to be more accountable to the loses made hence reduce embezzlement.
4. self discipline of politicians should be encouraged to reduce politicl interference in cooperatives.

5. government should support co-operatives by operating the price stabilization fund incase of low prices.
6. members borrowing money from co-operatives should present security inorder to reduce defaulting.

MARKETING BOARDS.

These are public bodies set up by government to assist farmers in the production, processing and marketing of agriculture products.

Specific aims of marketing boards.

1. To help farmers in order to produce high quality agriculture products.
2. To provide essential storage facilities for agricultural products
3. To assist farmers by improving efficiency in marketing processes to reduce competition amongst them.
4. To ensure steady supply of agricultural goods to the final consumers and processors.
5. To set and guarantee prices for the goods produced by farmers.

Types of marketing boards.

1. produce marketing boards
2. specialized industry boards.
3. advisory boards
4. monopoly export boards.

Examples of marketing boards in Uganda

1. Coffee marketing board
2. Lint Marketing Board
3. Produce Marketing Board
4. Diary Board
5. Uganda Tea Growers co-operation

Functions of marketing boards.

1. They buy produce from farmers in large quantities at fair prices.

2. they advice government when fixing prices of agricultural produce

3. they collect agriculture products from farmers and transport them to the market.

4. They ensure that produce from farmers is of high quality to meet the market standards.

5. Marketing boards can store agriculture produce on behalf of the farmer more especially during periods of surplus when prices are low.

6. they can offer credit to farmers in form of loans and inputs

7. Marketing boards can finance research in the development of best quality agriculture products.

8. They can control production by fixing quarters or limitations licenses to producers.

9. They can sale produce to local processors or export it to the world market.

10. Marketing boards can enforce quotation measures against pest and diseases within a particular area.

11. They can also disseminate research information to the farmers in villages.

12. Marketing boards can also invest money in public services like housing projects, hospitals etc.

Problems of Marketing boards.

1. political interference

Politicians through government interfere with activities of marketing boards.

2. Smuggling

This introduces cheap products on the market therefore reducing profits margins for marketing boards.

Price fixing
Marketing boards fix prices before harvesting and sometimes supply production mat come with problems of purchase.

3. Inadequate storage facilities that can cause losses to the boards hence low development.

4. Excessive production

Production in agriculture depends on weather hence favourable conditions cause over production leading to low market prices.

5. Delayed payment of farmers

This discourages farmers from selling their produce to marketing boards.

6. Poor road network in rural areas makes transportation of agriculture products more expensive and difficult for the marketing boards.

7. Loan defaulting

Some farmers fail to pay back the loan given to them by marketing boards which affects the performance of the marketing boards.