

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 Rearing

- It's a source of income most 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.
- Livestock 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 favorable environmental. Condition

Pests and Diseases

The presence of pests like ticks and tsetse flies has limited the rearing 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 bearing 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 means 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 fewer problems since he can raise the entire necessary infrastructure like dips, perimeter fences, and 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 be 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 make 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**Presence of 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.

Limited capital:

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

Poor 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 Climatic 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

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** CATTLE

<i>Bos taurus</i> /Exotic	<i>Bos indicus</i> / Indigenous
• Don't have a prominent hump.	• Have a prominent hump.
• Rounded ears held at right angles with the head.	• Have long drooping 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 Climatic 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 many reproductive problems
4. They cannot tolerate high temperatures and drought
5. They require high quality feeds for high production
6. They loose 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:

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 more easily 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 this may be caused by horned cattle to others.
- To prevent the destruction of farm structure like fences by animals those 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

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

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

Hot iron method:

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

Procedure

- Restrain the calf using ropes and cast it down
- Heat the iron in fire or gas until it's red hot.
- Apply the hot iron around the horn bud for about 10 seconds to burn the growing cells.

- Care should be taken not to go deep as it can damage the brain
- Apply fly repellants on the wound created to keep away flies and stop the wound from becoming septic respectively
- The animal should be released after the operation
- Monitor the animal to ensure that it does not go under rain

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 within 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

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

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

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

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

This is the removal of testicles of male animals to make them un able to fertilizing the female animals.

Is the making of the tests of male farm animals functionless.

Reasons for castration:

- To prevent the bad smell especially in the Billy goats, he goats.
- To prevent undesirable males from breeding.
- To make the animal docile and easy to handle.
- Castrated animals grow faster and produce quality meat.
- Castration increases the quality of wool in ram 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.
- It makes the animal suitable to perform in the farm e.g oxen
- It enables the animal to grow faster.
- It enables the animal to put on weight.

Methods of Castration

There are two main methods of castration namely:

- Open operation/ castration.
- Closed castration

A. 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/ the method is perfect and failure rate is zero
2. It's a cheaper method of castration since can be done using local implements like the knife

Disadvantages

1. It requires a lot of skill 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:

- The animal should be restrained first using ropes.
- Wash your hands using clean water and soap or wear clean gloves.
- The scrotum of the animals should be washed and disinfected using clean warm water and soap
- Dry the scrotum using a clean hand towel
- Apply a localized anesthesia around the scrotum to reduce pain
- Pull and squeeze the scrotum to locate the testes
- Use a clean blade or knife to cut the scrotum vertically in order to remove the testes.
- Pull the spermatic cords out and tie it using a clean string
- Cut the spermatic cord just below the knot to release the testis

- Repeat the same procedure to remove the second testis
- Seal the wound to stop bleeding by using a hot iron
- Apply fly repellants on the wound to keep away flies
- Apply antibiotic cream to stop the wound from becoming septic
- Release the animal and keep it in reach for easy supervision

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

B. 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/ **rubber ring method**

A burdizzo is an instrument with handles which exerts pressure on closing its jaws while a rubber ring is a thick round rubber which is stretched using an **elastrator** before being placed on the “neck” of the scrotum. In this method, the testis is not removed.

A burdizzo is a blood less tool used in castration

Advantages of closed castration

1. It's a fast method of castration
2. Does not require a lot of skill
3. No bleeding experienced
4. Less risk of infection since no open wound is created

Disadvantages

1. It is not totally perfect method because blood vessels and sperm duct may not be crushed. Chances of a failed castration are common
2. It is expensive to buy a burdizzo
3. Castration using a rubber ring is very painful

Castration using a burdizzo

- Restrain the animal using ropes and cast it down
- Pull the scrotum down wards to locate the spermatic cords, ducts and nerves
- Open the jaws of the burdizzo by pressing the handles out wards
- Place the burdizzo at the “neck” of the scrotum
- Press the handles of the burdizzo in wards to lock the jaws and crush the spermatic cords, ducts and nerves
- Open the jaws of the burdizzo and remove it from the crushed area
- Release the animal after the operation
- Keep the animal within reach for easy supervision

Castration using a rubber ring:

Here a strong rubber band is straightened using an **elastrator** and fixed around the “neck” of the scrotum. 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.

Procedure

The animal is confined or restrained

A rubber ring is stretched by use of an elastrator.

Pass the scrotum through the stretched rubber ring.

The stretched rubber ring is then put at the neck of the scrotum.

The stretched rubber ring stops the circulation of blood to the testes.

The rubber ring falls after some time.

Release the animals.

Advantages

The method is blood less or no wound is formed. It is easy

The risk of infection is reduced.

Note.

A castrated bull is called a steer and they are used in ploughing (oxen).

Caponisation

This is the method of castration carried out in poultry (male birds).

A chemical hormone in form of pellets is injected under the skin at the back of the neck.

The effect of the hormone lasts for six weeks.

The castrated cock is called capon.

3. IDENTIFICATION:

This is the practice of putting marks, labels or numbers on farm animals. It involves branding, ear notching, ear tagging and tattooing.

Importances of animal identification.

It helps farmers to carry out proper record keeping.

It prevents disputes among neighbours in case of lost animals.

Enables farmers to claim or track for the lost animals.

Methods of identification:

The main methods of identification are:

- Branding
- Ear tagging
- Tattooing
- Ear notching
- Naming

A. BRANDING

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

Methods of branding

These include:

- Hot iron branding
- Chemical branding

- Freeze branding

I. 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 for a very short time.
- The hot iron destroys the air follicles and a scar remains at the branded part.
- Some oil is smeared over the parts to increase healing.
- Release the animal from the crush

Note.

Hot iron branding should be done on areas low economic values as at the base of the tail, forehead, the jaw etc.

II. 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 from the crush

III. 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.

The coldness destroys the hair follicles.

B. EAR TAGS

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

Ear tagging is a practice of putting tags with numbers or letters on the ear of animal.

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, Newcastle, rabies etc.

10. DRENCHING

This involves administering oral treatment as supposed to animals. It's done using a drenching gun/bottle to control internal parasites like liver flukes, round worms, tape worms, and 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. Should be large enough to avoid overcrowding of the animals
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 behavior 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

- To maintain desirable qualities in animals like increased number of eggs produced in chicken, high number of off springs born per animal,
- Produce animals with a high mothering ability i.e. low temperament and high milk production
- Produce highly fertile animals

- Produce animals with a High growth rate
- Produce animals that can give lot products like milk and eggs
- To come up with breeds that produce high quality meat, milk and egg
- To produce breeds of animals that is resistant to parasites and diseases
- Elimination of undesirable qualities in livestock
- To produce animals with a high resistance to harsh environmental conditions
- To produce animals that can provide products for a long period of time

TERMS USED IN ANIMAL BREEDING

Allele: These are different forms of a gene at a particular locus e.g. Tt

Back Cross: This is a cross between an animal offspring and one of the parents

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.

Breeding: This is a technique involved in mating selected animals because of their desirable characteristics.

Chiasma: This is a place of connection between two chromosomes seen during prophase I of meiosis.

A clone: This is the population of organisms reproduced by a sexual reproduction from a one individual.

Crossing over: This is the process of exchange of genetic information between two homologous chromosomes during meiosis.

Diploid: It's an individual cell having 2 complete sets of chromosomes.

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**.

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.

Inheritance: It's a mechanism by which characteristics are passed on from parents to off springs. If a character is 20% heritable. It means that the 20% is determined by the genes while the 80% depends on the environment.

A hybrid: These are the off springs resulting from a cross between two parents of different breed or stock.

Hybrid Vigor: (heterosis) this is unusual 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

Inbreeding: This is the mating of closely related animals

Locus: This is the physical position of the gene on a chromosome

Linkage: This is the tendency of genes located on the same chromosome to be inherited together in a successive generation

Out Breeding: This is the mating of unrelated animals and is sometimes called crossing

Pedigree: It's a chart showing the ancestry history of an individual

Progeny: These are off springs resulting from a mating

Recessive Gene: A gene whose expression is only seen when in a homozygous state only.

Heterozygous: It's a situation where an organism has two different alleles e.g. Tt

Homozygous: It's a situation where an organism has two like alleles e.g. TT

Sex chromosomes: These are chromosomes that determine the sex of organisms e.g. X and Y chromosomes in animals.

A. 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 it's 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 animals 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

- Adaptability of the animal to environmental conditions
- Availability of the breed with in the environment
- Availability of market for animal products for the animal being bred
- Animal temperament should be low for easy handling
- Animal resistance to pests and diseases should be high
- Animal body conformity should confirm the breed and type
- History of success of the breed in the environment
- Feed conversion ratio of the breed i.e. should have a high ability of converting feeds into products like milk , meat and eggs
- Growth rate of the breed

- Availability of quality feeds for the animals
- Fertility of the animal being considered
- Productivity of the animal in terms of milk, meat and eggs

B. 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 off springs 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 mated 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;

- **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.
- **Age of heifer at first calving:** This should be 24 months. A higher age indicates a low breeding efficiency
- **Number of Service per conception.** The ideal ratio should be 1.6-1.8
- **Percentage of cows that calve within a year.** A high percentage indicates a high breeding efficiency
- **Number of days a cow is pregnant in a year.** The more the days, the higher the breeding efficiency
- **The percentage of non-returns.** Non-returns arise when the service is done and pregnancy does not occur. A low percentage of non indicates a high breeding efficiency and vice versa

Maintaining a high breeding efficiency

Good feeding: Breeding animals should be fed well but excessive fattening should be avoided as it may reduce the fertility.

Observing the rest period: Animals should be given a rest period of about 60 days to allow the uterus to return to normal

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

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.

Veterinary Attention: Animals that fail to conceive should be identified and examined to find out the causes and treated if possible.

Pregnancy diagnosis: Animals should be diagnosed to find out whether they have conceived or not so that appropriate measures can be taken in time.

Keep accurate breeding records for the herd to be used as reference were necessary

Use teaser bulls for early detection of heat in farm animals for early service

Maintain a good ratio of bulls to females to avoid over working the bulls which lowers fertility
Use correct **techniques of artificial insemination** to ensure successful fertilization hence high breeding efficiency

Females with abnormal discharges should be examined and treated early enough

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**

A. NATURAL SERVICE

This is where a 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 female
5. Breeding records are difficult to keep

B. 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 contact between the males.

Advantages

- Its 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
- Its 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 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 are 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 behavioral changes.

The female oestrus cycle

- The anterior pituitary gland secretes a hormone called follicle stimulating hormone (**F.S.H.**) which stimulates the growth of graffian 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 **Luteinizing hormone (LH)**.
Oestrogen makes the female animal more receptive to the male and increases sex urge in females.
- **Luteinizing hormone** causes the rapture of mature follicles to release the ova in the process of ovulation.

- After ovulation, luteinizing 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 luteinizing hormone from the anterior pituitary gland.
- After a successive fertilization, the progesterone stimulates the growth and improves blood supply to the endometrium 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 a female animal simultaneously produce several ova which are fertilized to form embryos

Objectives of MOET

1. Increases the number of off springs in the life time of a female farm animal
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 days	18-28	5-15	335
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 cows
- The animal becomes restless i.e. moves up and down in search 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 mucous 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 it's 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 it's 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.
- **Cryptorchidism**: This is when the male animals are born with both testes retained in the abdominal cavity making it unable 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 rupture 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.
- Unfavorable conditions in the reproductive tract of a female can cause infertility
- Use of defective sperms during service lowers animal fertility

SIGNS OF PREGNANCY

- 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

- Provide clean water to the animal without any restriction
- Carry out pregnancy diagnosis two month after service to confirm pregnancy
- Dry off the animal at the 7th month of pregnancy to prepare it for the next lactation
- After drying carry out dry cow therapy to control mastitis
- Regularly deworm the animal to control internal parasites that may affect the unborn calf
- Provide adequate feeds through out the period to cater for high nutrient demands
- Steam up in the last 2 month of pregnancy to prepare the animal for lactation
- Regularly control external parasites by spraying At least twice a week
- Vaccinate the animal against killer diseases so as to protect the unborn calf
- Isolate the animal in the last 2 month from the general herd in put it in a nurse paddock
- Provide a clean dry calving pen for the cow
- During calving, assist the animal with difficulties
- Milk the animal a little to reduce the udder pressure
- 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 months prior to calving.

Importance of steaming up

- It prevents nutritional disorders associated with milk secretion like milk fever
- It allows the heifer to get used to the milking place when steamed in a milking parlour.
- Replaces the nutrients that have been used in the development of the foetus
- It prepares the cow/ heifer physiologically for the next lactation period.
- Allows the animal to put on weight in preparation for calving
- Makes a heifer get used to feeding on concentrates
- Stimulates the development of mammary glands for milk production
- Encourages the production of high quality colostrums for the calf at birth
- For proper growth of the foetus

Signs of calving

- The cow / heifer stay away from the general herd and lies down rather than standing.
- The udder becomes extended as well as the teats
- The cow becomes increasingly uneasy
- Loss of appetite
- The vulva becomes flabby (becomes soft and loose)
- There is frequent urination
- Repeated arching of the back and raising of the tail

Care of the cow at calving

- The animal should be taken to the calving paddock or stall
- The place where the cow is to calve should be clean and free from sharp objects
- The animal should be let to deliver by itself for at least 1 hour
- In case of failure, the veterinary officer should be called in for help.
- Remove the after birth as soon as possible

Care after calving

- The calf should be left with the mother so that it can clean it by licking.
- Normally, the calf removes the mucus membrane from the nostrils by sneezing
- 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
- Give the cow warm water to drink so as to assist in the digestive system
- Disinfect the naval cord of the calf with iodine to reduce infections
- Milk the cow a little to release the pressure in the udder
- 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. In case the calf fails to breathe normally, artificial respiration should be initiated
4. Leave the calf with the mother to ensure that it takes colostrum
5. In case of artificial rearing, the calf should be trained to drink from the bucket within two days after birth
6. Feed the calf on clean milk At least 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 At least 2 weeks after birth
11. Male calves that are not going to participate in the breeding programme should be castrated in the 4th week from birth
12. Remove extra teats from female calf 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

- Calf scours characterized by diarrhea with a foul smell
- Calf pneumonia; this caused by poor housing conditions
- Navel infection; this caused by bacterial attack of the navel creating septic conditions
- Internal worm infections resulting into stunted growth and diarrhea
- Calf Coccidiosis characterized by feces with foul smell. It is caused by bacteria
- 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:

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:

It contains very high antibody content about 5 times more than normal milk.

It has a high protein and vitamin content

Reasons for giving the calf colostrum

- Contains antibodies which help the calf to fight disease
- Removes sticky materials from the alimentary canal of the calf
- It contains a lot of nutrients which are needed highly by the calf.

- It is easily digested

Methods of feeding / rearing the calves

Natural rearing/Suckling:

Artificial rearing / bucket feeding

✓ **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

- It is the simplest and best way of producing large healthy calves
- It is a suitable method for the beef farmers who have a little interest in milk but more in the beef of the animals.
- It is Labour saving as compared to the artificial rearing
- Diseases due to unhygienic conditions e.g. Calf scours observed in bucket feeding are rare in this system
- Calves get milk at the normal body temperature which enhances proper digestion
- This is the most suitable method of raising calves in places with low market for milk.
- There is low mortality rate under this method of raising calves.

Disadvantages of single suckling

- It is very difficult to keep feeding records in this system since the amount of milk taken by the calf is not known.
- Injury to the teats is common as the calves suckle

✓ **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

- Well grown calves can be realized with proper management
- There is a tendency of getting a high milk yield from the dam as it is milked in the presence of the calf.
- There is low mortality rate since calves get clean milk at the right temperatures
- Less cases of mastitis are noted under this method
- It saves both Labour and time.
- Provision of supplementary feeds to calves would greatly improve their growth.

✓ **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

- The dam will give more milk when the calves are left to suckle it.
- The method gives good calves as compared with bucket feeding.
- The method uses less Labour since supervision is little
- The calves are able to get the milk at the normal body temperatures
- There are fewer cases of calf scours
- Case of mastitis in cows is rare
- Milk from other dams can be saved for the market

Disadvantages

- In case of an infectious disease, a farmer may lose a good number of calves.
- Weak calves are denied a chance of suckling at most times by the strong aggressive calves.
- Injury to teats caused by the calves is more common
- 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

- The calf should be removed from the dam three days after birth to ensure colostrum intake.
- Immediately After milking, the bucket with the milk should be presented to the calf for training.
- Wash your hands with clean water and soap and dry using a clean hand towel
- The trainer should dip the index and middle fingers in the milk and later place it in the calf's mouth
- The calf suckles the fingers as the trainer lowers the hand in the bucket containing milk.
- As the mouth of the calf approaches the milk in the bucket containing milk, slowly to allow the calf to suckle
- The calf begins slowly to drink the milk and later learns
- 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.
- Training can be repeated until the animal learns

Advantages of bucket feeding

- It is easy to keep feeding records that can be referred to in any case since the amount of milk taken is known
- Calves can be easily rationed according to their body needs
- The farmer can introduce milk substitutes easily and therefore save milk for market.
- The method permits early weaning which can save milk
- The dam will give milk even when the calf dies
- It encourages better management of the herd since the lactating cows are fed according to their production.

Disadvantages

- The mortality rate in this system is high since in most cases calves are given less or dirty milk.
- Calves are more prone to diseases due to unhygienic conditions associated with feeding the calves
- The method requires more labour and attention which are expensive to the farmer.
- In case 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, Jamaican hope, brown Swiss and Kerry

Characteristics of a good dairy breed

- Should be a high milk yielder
- Should be resistant to pests and diseases
- Should have a high fertility
- Should be docile hence easy to be milked
- Should have a large udder
- Should be able calve easily
- Should have a big milk vein
- Should be able calve regularly for along time
- Should have a well suspended udder with four functional teats
- Should have a long lactation which ensures continuous milk production
- Should have strong hind legs for supporting a big udder

Factors to consider before establishing a dairy herd

Capital

This is needed in the construction of farm structures, purchase of land and the animals.

Land

There should be enough land to accommodate farm buildings and paddocks where animals can graze from

Labour

Both skilled and unskilled Labour is required for performing specialized work and manual Labour respectively.

Reliable source of water:

Water is needed by the animals for drinking and also in other farm operations like cleaning and mixing of drugs.

Ready market

For milk and milk products which are easily accessible to reduce the costs incurred in looking for market.

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.

Reliable transport

So that the farmer can easily move farm products to the market and bring back inputs

The breed

Selected breed should fit the market demand and the Climatic conditions of the place inconsideration.

Security is a very important factor for any business since insecurity results into loss of property and life

Government policy in place should be encouraging dairy farming through the provision of good breeds of cattle

Climate in the area should be good for dairy farming

Importance of Dairy farming

- Provides income to the farmer all year round since animals produce at any given period of the year
- They can provide dung used for making farm yard manure
- Can provide quality meat at the end of milk cycle after fattening
- Provide food to the farmer in form of milk
- Provide market for industrial products like meat
- They are good converters of inedible pastures into milk

Strength of the dairy industry in Uganda

- High demand for dairy products in Uganda
- Integrated farming practices can accommodate dairying
- Suitable climate in most areas of Uganda that favours animal production
- Availability of quality fresh pastures through out the year
- Improved infrastructure that make transportation of milk to the market easy

- Increased research and development in dairy farming
- Improved extension services in dairy farming
- Historical factors like a long history of cattle keeping among tribes in Uganda

Introducing exotic dairy cattle in an area

- Fence off the whole grazing area to keep out intruders and pests
- Partition the grazing land into paddocks for easy pasture management
- Remove all weeds and injurious objects from the grazing land
- Install water points in all paddocks for the animals
- Introduce bait animals to the paddock to control ticks 3-6 months before bringing in the exotic animals
- Spay or dip the bait animals regularly over the whole period
- Remove the bait animals after a specified period and introduce the exotic animals
- Regularly spray or dip the exotic animals to control external parasites

MANAGEMENT OF DAIRY CATTLE

Kindness to animals: Rough handling of animals like beating reduces the productivity and can even cause injuries that may be expensive to treat.

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.

Grooming : Keeping hind quarters of animals off dung, loose hair and any dirt by brushing and dipping leads to production of high quality milk.

Hoof trimming: Overgrown hoofs should be trimmed to avoid difficulty in movement and lameness

Dehorning: Apart from introducing uniformity in the herd, handling of dehorned animals is easy and less risky

Identification: For record purposes, dairy animals should be identified by ear tagging notching, branding and tattooing.

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.

Breeding: A farmer should aim at breeding of his herd to increase animal number and productivity by incorporating good breeds in the breeding programme.

Proper feeding; dairy animals should be given enough and highly nutritious feeds to improve and maintain a high level of production

Regularity of care: The operations done on these animals should be performed regularly without abrupt interruptions as those may affect the production of animals

MILK SCIENCE

This is the way how milk is harvested from a cow.

Structure of the udder

Milk secretion

- I. Milk is secreted by the secretory cells called **alveoli secretory cells** in the udder under the influence of **Prolactin** hormone from the anterior pituitary gland
- II. Milk is made from the nutrients eaten by the animal like blood sugar, amino acids and fatty acids
- III. Vitamins and minerals can be added to milk from blood
- IV. 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

Reasons why milk is highly perishable

- Milk contains a lot of nutrients that attract pathogens
- Milk contains a lot of fats that easily go bad
- Milk easily absorbs the smell from the surrounding
- Milk contains a high amount of water content

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

- ❖ 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**.
- ❖ A hormone called **Oxytocin** is released in the blood stream from the anterior pituitary gland.
- ❖ When the hormone reaches the udders it causes contraction of muscles surrounding the **alveoli**
- ❖ The squeezing action forces the milk into the **gland** and **teat cisterns**
- ❖ the effect of the Oxytocin also causes the annular fold to relax and open up the teat canal
- ❖ the sphincter muscles too relax allowing milk to flow out
- ❖ The action of suckling / milking will bring the milk outside.

Ways of stimulating milk let down

- Taking the cow to the milking parlour
- Massaging the udder or washing it with warm water
- Noise or rattling of milk buckets
- Feeding of the on concentrates cow in the milking parlour
- Approach of milking time
- 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 process when the milk let down is stopped. It occurs when the animal has been disturbed

- ❖ When the animal is disturbed or frightened or excited by either sight of strangers at the a parlour a message is sent to the brain via the spinal cord
- ❖ The brain commands the adrenal glands to secret adrenaline hormone that flows into the blood stream and pumped to the udder by the heart
- ❖ When the adrenaline reaches the udder it causes the alveoli to expand and hold up the milk and causes the annular fold to contract closing off the teat canal and the sphincter muscles too contract and milk flow is stopped

Causes of milk hold up

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

- Assemble all milking equipments like buckets, cans and milking strainer in the parlour to avoid time wastage.
- The cow to be milked should be restrained while in the parlour by tying the hind legs with a milking rope.
- Wash the udder with warm water and soap and dry it using a hand towel.
- Milking salve should be smeared on the teats to reduce friction and injury to teats
- A strip cup should be used to test milk from each teat for mastitis
- Cows suspected of mastitis should be milked last and the milk poured away
- Follow the right milking technique of applying pressure to the outside of the teat while holding the teat between the index finger and thumb.
- Weigh and record milk from each cow immediately after milking
- 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.
- 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:

- ✓ It is free from dirt and any other visible matter
- ✓ has normal composition
- ✓ Has desirable flavour
- ✓ Free from harmful bacteria

In order to produce clean milk, the following points are important:

- Clean, healthy cows must be maintained free of brucellosis and tuberculosis
- Regular grooming and washing of animal is important for removal; of dirt and l loose hair that can contaminate milk.
- All the equipments used during milking must be kept sterile by washing and drying.
- The milking parlour should be kept spotlessly clean to reduce contamination of milk by microbes
- Personnel handling milk should be clean by having clean clothes, short hair and finger nails
- Milk should always be covered when in containers to stop foreign material from entering it.
- The person milking should not be suffering from any contagious disease e.g. Tuberculosis.

- Cows suffering from mastitis should be milked last and the milk poured away to reduce the spread of the disease.
- Regular tests for tuberculosis in the herd should be carried out regularly and animals found with tuberculosis should be cull
- Before milking, the milker should wash his hands thoroughly and dry it with a hand towel to reduce contamination of the milk with dirt.
- 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.
- The milking parlour should be built on a high ground to permit good drainage
- Wild plants which have an odour that can taint milk should be removed from the milking place.
- Milk should be cooled from the normal temperature of 37°C to 4°C to reduce bacteria multiplication.
- Proper milking techniques should be followed to reduce injury to teats and contamination of the milk.

FACTOR AFFECTING THE QUALITY (COMPOSITION) AND QUANTITY (YIELD) OF MILK

Breed

Friesians produce large amounts of milk but of low butter fat while the indigenous produce less milk of high butter fat.

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.

Period of lactation

Milk yield increases until the 7th week then it starts declining up to drying off.

Animal Health

Sick animals give less milk which may also contain antibodies and drugs more especially after treatment.

Animal Temperament

Quiet animals are the best milkers while nervous cows which kick about give less milk.

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

Food eaten

Animals fed on concentrates will produce more milk which is of better quality than those feed on the ration full of roughages.

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.

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.

Temperature

High temperatures reduce milk yield due to the increased evaporation of water of water from the animal's body.

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.

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

1. Hand milking

Advantages

- Spread of mastitis is limited as compared to machine milking where mastitis is easily spread through the teat cups.
- Hand milking has a low initial capital and therefore peasants can afford it.
- It can not be limited by power therefore more applicable to rural areas with no power.
- Injury to teats is not common as witnessed in machine milking due to faulty machines.

Disadvantages

- It is very slow in operation and therefore can not cope with large herds.
- Efficiency declines with increase in the time worked
- It is difficult to produces clean milk under this method
- It is difficult to have complete milking hence a farmer stands to loose.
- It increases Labour costs as more people are employed.

2. MACHINE MILKING

Advantages of machine milking

- It produces clean milk more easily than hand milking
- Complete milking is easily achieved
- There is reduction of Labour cost since one person can handle more than 1000 cows in a short time.
- It is faster in its operation hence saving time for animals to graze.
- Can easily cope up with a large piece of work without getting tired.

Disadvantages

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- Needs skilled Labour to operate the machine which may be difficult to attain.
- It's limited by power supply and can not work in places with no power.
- Faulty machines can cause injury to teats
- Diseases like mastitis are easily spread since the animals share the same teat cups
- The initial cost of buying and installing the machine is high for most of the farmers in Uganda
- It is only economical on farms with very large numbers of lactating animals.

DISEASES ASSOCIATED WITH LACTATING COWS

✓ **Mastitis**

This is an inflammation of the udder caused by a number of bacteria and the most common are: - Streptococci and staphylococci

TYPES OF MASTITIS

➤ **Acute Mastitis:**

This is sudden in occurrence, marked with changes in the udder.

➤ **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

- Blood stains in milk
- Flakes and clots in milk
- Discoloured milk

Treatment of mastitis

Use intra mammary 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 sores 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

✓ **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 animals 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, Charolais, short horn, Lincoln red, Sussex 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

Harsh Climate

Long droughts that are rampant in many places of Uganda have led to the scarcity of pastures and water hence decreasing animal productivity.

Poor Soils

Potential areas for beef production have poor soils which cannot support quality pastures for the animal.

Presence of 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.

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.

Conservativeness

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.

Poor Markets

Animal markets are poor and far from the production areas making transport to be difficult and expensive.

Poor Animal Breeding

Animals are mated while young and little time is spent on selecting the right breeds that are productive.

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.

Inadequate land

Most areas 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 animals 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.

Parasites

Apart from transmitting pathogens, animal parasites can extract a lot of nutrients that are supposed to be used by the animals' body.

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

- To decrease the animal fluctuations in stocking numbers
- To reduce the seasonal fluctuation in live weight of stock
- To minimize reproductive performance towards the ideal of one calf per cow per year.
- To minimize calf mortality and losses due to diseases
- 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

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.

The Grazing Area

All shrubs and trees which hinder good growth of grass of which could Harbour tsetse flies should be removed.

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.

Breeding

Cows should be serviced by healthy bulls to control diseases which can be transmitted by breeding or A.I should be used.

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 SLAUGHTERING AN ANIMAL

✓ **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.

✓ **Ante mortem inspection**

Inspection of the animal to check for any deformities, injuries, sex etc. is done at this stage.

✓ **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.

✓ **Actual Slaughter**

The neck of the animal is cut and it's allowed to bleed by hoisting it up. Adequate bleeding is essential to reduce meat spoilage.

✓ **Skinning**

This is the removal of the hide or skin from the dead animal. It should be done with a lot of care to avoid damaging the hide or skin

✓ **Evisceration**

This is the cutting open of the carcass to remove the internal organs.

✓ **Post mortem Inspection**

This is the postmortem inspection for infection for tuberculosis, cysts etc.

The carcass has to be passed for public consumption. Condemned carcasses are buried / burnt.

✓ **Grading**

The products looked for is fat, degree of marbling, texture of meat and colour. A pale colour indicates poor quality. Marbling is the distribution of fats within muscles

✓ **Curing, cooling, refrigeration**

These are imagined at preserving the quality of the meat. Meat should be stored in a cold room or refrigerator to reduce multiplication of micro organisms that may lead to rotting

✓ **Slaughter house regulations**

The slaughter house should be cleaned after slaughter to reduce bad smell and cases of meat contamination

Common terms used during Butchery

❖ **Live weight**

This is the weight of the animal when still alive

❖ **Dressed weight**

This is the weight of the carcass after removal of the skin, head, and internal organs

❖ **Killing out percentage**

This is expressed as the dressed weight divided by the live weight and expressed as a percentage

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

FACTORS THAT MAKE MEAT UNFIT FOR HUMAN CONSUMPTION

Parasite infestation

Internal parasites like liver flukes, tape worms make meat unfit for human consumption

Drugs

After treating animals with drugs their meat should not be eaten for a certain period of time

Rotting

Rotten meat is not good for human consumption. Rotting is caused by poor sanitation, poor preservation

Dirty slaughter houses

This lead to contamination of the meat with rumen contents making it unfit for human consumption

Bad smell or flavour

Meat with a bad smell is not fit for human consumption

Age of the animal slaughtered

Meat from very old animals is tough, hard. This type of meat is not fit for human beings but canines

Dirty means of transportation

Dirty boxes used to transport meat may lead to meat contamination making it unfit for human consumption

Poor marbling

Meat fit should have a good ratio of fats to muscles

FACTORS THAT INFLUENCE THE RATE OF MEAT SPOILAGE

Diseases

A carcass that had a disease tends to rot faster compared to a healthy carcass

Bleeding

Poor bleeding during slaughter leaves a lot of blood on the meat and this blood encourage rapid rotting

Moisture content of the meat

Bacteria attack is higher on meat stored in wet conditions increasing on meat spoilage

Preservation done

Meat that is preserved does not easily rot compared to meat that has not been preserved

Transportation

Use of dirty boxes to transport meat contaminates it increasing on meat spoilage

Temperature of the environment

High temperatures in the tropics encourage multiplication of bacteria that increase on meat spoilage

Rumen contents

This increase on the rate of meat spoilage when they get in touch with the meat

Slaughter houses

Dirty houses lead to contamination of the meat which increases on the rate of meat spoilage

HIDES AND SKINS

Uses of hides and skins

- 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

✓ During the animals life:

- Injuries / wounds that may be caused by rough handling and sharp objects such as barbed wire.
- Some parasites like ticks can cause wounds which will eventually lower the quality of the hide or skin
- Diseases like ringworms in cattle and goats can also damage their skins by causing open wounds
- Bad branding more especially at the thigh and back will lower the quality of hides and skins
- Bad roping can cause calluses and wounds which will eventually lower the quality

✓ **During slaughter and flaying**

- Incomplete bleeding which causes blood to remain in a hide or skin attracting microbes that may lead to putrefaction.
- Dragging carcass on the floor or over sharp objects can damage the hide
- Delay in flaying after killing the animal will make the whole process more difficult hence prone to more mistakes during flaying
- Use of pointed knives which may accidentally make holes in the hide/skin
- Mixing the hide with dung or blood during the process of flaying the carcass attracting microbe that speed up putrefaction
- Failure to wash and dry the skin immediately after flaying can encourage rapid decomposition hence reduction in quality.
- The fresh skin should not be folded with the hair inside as this creates anaerobic conditions that speeds up putrefaction
- 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**

- Causes flaking due to over drying since temperatures are high on the ground
- The fat on the skin/hide will melt and spread all over increasing chances of microbial attack.
- Rain drops can collect on the hide/skin which may easily encourage decomposition and hence loss in quality
- The outside of the hide/skin is hard while the inside is soft ie.
- There is uneven drying.
- There is putrefaction of the hide/skin more especially in spots which touch the ground

✓ **Damage during transportation**

- Bad packing causes the hide/skin to rub against each other which may lead to damage
- During transportation, rain can soak the hides/skin encouraging microbial action on them

✓ **Damage during storage**

- Pests like the rodents and insects can attack the hides while in store more especially if stored in poor houses
- Moisture from leaking stores can soak the hide/skins speeding up decomposition

SMALL RUMINANT PRODUCTION

Small ruminant are kept for milk, meat and skins. The main animals here are sheep and goats

Advantages of rearing small ruminants

- They require small initial capital so poor people can easily start such a venture without much external financial assistance.
- Their reproduction turn over 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 ruminants 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

- Shortage 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 exotic 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.

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 graze freely in uncultivated land or a garden with crop residues. This system is common in arid and semi arid areas with low human population.

1. BREEDS OF GOATS IN UGANDA

➤ Small East African Goats:

This is the largest breed in Uganda making up to 42% of the total goat population.

Characteristics

- they are small in size
- they mature early reaching a live weight of about 23 – 30kg
- they reach sexual maturity at about 4 months
- they have a fine hair coat with various colour
- Most of them are horned and they are mainly kept for meat.

➤ **Mubende Goat**

This is found in areas of North and North West of Lake Victoria.

Characteristics

- It is a larger breed than the small East African goat.
- The mature live weight ranges between 30 – 35 kg for males and 25 – 30 for the females
- It has straight and short hairs
- It is predominantly black in colour though black and white are other colour.
- It has a long neck
- The body conformation of the female is angular

➤ **Kigezi**

This is usually found in the highlands of south Western Uganda

Characteristics

- It has a thicker hairy coat than the other two breeds
- It has spaced long hair around the hind quarters
- It is small, more compact with short legs.
- They have black and grey hair coat
- At maturity, they can weigh between 25 – 30kg

2. SHEEP

The main breeds of sheep reared in Uganda are:

- Red Masai sheep
- East African black head sheep
- East African long tailed sheep

POULTRY

These are birds that have been selected and domesticated by man, e.g. Domestic fowl, chicken, ducks, Turkey, geese, guineas fowl.

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
- shortage 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 300 breeds of chicken in the world. Commercial breeds can be divided into 3 groups.

❖ Egg producers e.g. leg horn.

These have the following characteristics:-

- consume less feeds
- produce more eggs
- Produce white eggs mainly.
- They do not go broody

❖ Duo-purpose breeds

- They have characteristics
- They produce brown eggs
- Consume more feeds than egg producers
- They are better meat producers than the white leghorn.

Example Rhode Island Red, New Hampshire.

❖ Meat producers

Characteristics

- They have a low egg production capacity.
- They show much broodiness than the other two.
- Produce fast growing chicks
- Have a high weight at maturity

Examples white Cornish, white Plymouth.

CHARACTERISTICS OF A GOOD POULTRY HOUSE

- It should be water proof to avoid damp 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

Beak

It's composed of two horny parts i.e. the upper and lower beak. It picks food and passes it to the crop via the gullet.

Gullet

This acts as a passage for food from the mouth to the crop.

Crop

It Stores food before proceeding to the glandular stomach It also softens the food.

Glandular stomach

This is an enlarged part just before the gizzard. Its wall contains many glands that secrete hydrochloric acid. It's also referred to as the first stomach.

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.

Small intestines

The 1st part forms the duodenal loop where most of the digestion takes place.

Digestion of fats, proteins and carbohydrates takes place here.

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.

Large intestines / colon

It's relatively short of and it's where absorption of moisture takes place.

Vent / cloaca / Common sewer

The digestive, urinary, and reproductive tract empty here their products.

REPRODUCTIVE SYSTEM OF POULTRY

It comprises of the following: infundibulum, magnum, uterus, vagina, and isthmus.

Infundibulum

It's 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

The egg membranes are also formed here, the shape of the egg is determined 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. 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

Level of feeding; giving adequate amount of feeds leads to high level of laying

Quality of feeds give; well balanced ration ensure high production of eggs

Health of bids; sick birds will lay less eggs of poor quality

Pest attack; pests cause stress in birds which lowers egg production

Temperature in poultry house; high temperature reduce feed and water intake which will lower egg production

Breed; high laying breed produce more eggs than the meat producers

Provision of enough water; giving less water affects body metabolism which may lower egg production

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/FREE RANGE

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 all over 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.

2. POULTRY RUN

In this system birds are rotated in paddocks for a particular period of time during day. They are later confined 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 outside 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.

3. FOLD SYSTEM

Here birds live all 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.

4. BATTERY / CAGE SYSTEM

This is an intensive system of poultry production where birds are kept in individual cages indoors of about 0.14m².

Feeders and drinkers are arranged at one side.

The wire making up the floor is slatted 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 located 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

5. 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, drinkers, 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 TO ENSURE HIGH EGG PRODUCTION

- 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

- Periodic racking to remove feathers and spreading of droppings.
- Removal of wet litter spots
- Addition of agricultural lime at a rate of 4g/10m² to increase moisture absorption.
- 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

- Drinking water that may splash over the litter as birds drink it
- Moisture from accumulated chicken droppings
- Rain water from leaking roof
- Capillary water from underground in poorly drained places
- Rain water through the windows during storms due to a short overhang of the poultry house
- Flooding of the site
- Overcrowding of birds that increases humidity
- 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

Heredity: some line of birds show more vices like cannibalism than others.

Overcrowding in the poultry houses can cause vices like cannibalism as birds become more close to each other

Introduction of new birds in a flock with unique characters of the body and size may cause cannibalism and feather pecking.

Exposure of wounds and smell of blood can cause cannibalism

Lack of enough laying boxes which causes breakage of eggs and exposes eggs to the birds can easily result into egg eating.

Improper feeding of the birds that encourages mineral deficiency can lead to cannibalism

Bright light in the poultry house can stimulate feather and toe pecking.

Insufficient drinking and eating place may also lead to pecking as birds struggle to get near to feeds and water.

Irritation of the skin through direct sunlight and lice infection can result into cannibalism and pecking.

Diseases like Gumboro can easily cause cloaca pecking since the droppings usually stick in that area.

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

- ❖ The farmer should provide enough laying boxes that should be placed in easy to reach dark places.
- ❖ The birds should be debeaked between 9 – 12 weeks in order to control egg eating.
- ❖ Give the birds' balanced feeds to reduce the laying of soft shelled eggs that easily break and cause egg eating.
- ❖ Over crowding of the birds in the poultry house should be avoided by reducing the stocking rate.
- ❖ Greens to be fed to the birds should be hanged over their heads so that birds are kept busy.
- ❖ Sick birds and weak ones should be isolated from the general flock to control cannibalism.
- ❖ The farmer should remove all the slow moulting birds from the general flock since such birds encourage cannibalism.
- ❖ The breeding stock should be selected from the birds that do not show any sign of vices.
- ❖ The nests should be enough and must be well positioned to reduce accidents that can cause breaking of the eggs resulting into egg eating.
- ❖ There should be enough feeds and water troughs for the birds.
- ❖ Birds with lice infection and gumboro disease should be culled.
- ❖ 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;

- ❖ Change of feeds i.e. from layers mash to growers mash
- ❖ Change of feeding routine
- ❖ Starving birds or inadequate feeding
- ❖ Vaccination of birds leading to pain

- ❖ Debeaking birds
- ❖ High temperatures in the poultry house
- ❖ Presence of parasites on the birds
- ❖ Overcrowding in poultry house
- ❖ Change of the environment around the birds i.e. moving birds to a new place
- ❖ Noise of predators around the poultry house

Effects of stress

- ❖ Reduce egg production in birds
- ❖ Reduce bird appetite
- ❖ May cause disease in birds
- ❖ can reduce growth rate in young birds

Question; explain how a farmer may control stress in birds

Characteristics of a good laying bird:

feature	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 At least 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 among birds.

METHODS OF INCUBATION

There are two main methods of incubating eggs i.e.

Natural incubation

Artificial incubation

1. Natural incubation

This is where a broody hen seats on a clutch of eggs to provide conditions suitable for hatching to occur.

To provide conditions 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.

2. 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:

❖ Optimum Temperature:

This has to be effectively controlled between 32.2°C – 37.2°C.

Higher temperatures can cause death of embryos especially from the 19th 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.

❖ Adequate 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.

❖ Adequate Air supply

21% oxygen is required in the incubator to allow adequate gas exchange between the embryo and out

❖ Regular 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

❖ The must be fertilized

❖ Egg must not have any defects like cracks and double yolks since such may not hatch

❖ Providing a good nesting place to avoid breakage of eggs

❖ Ensuring that the place of incubation is free from pests and vermin

❖ 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:-

- Clean and fumigate the incubator / hatchery before setting in eggs.
- Select clean eggs and fumigate them before incubation.

- The hatchery should be located far away from any nearby poultry farm.
- Have the incubator in a separate room where you meet people.
- Do not allow visitors in the hatchery except the hatchery attendant.
- Vaccinate chicks against Newcastle immediately after hatching.

SEXING OF CHICKS

Sexing is the grouping of chicks according to their sex.

Methods of sexing

- ❖ **Vent method** This is based on observation of the vent where the male chicks have three protuberances (round part that sticks out) from the vent while the female have only two.
- ❖ **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.
- ❖ **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 F₁ generation.

BROODING

It's the provision of conditions for growth of chicks. **A brooder** 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°C by providing a heat source.
2. Set up a brood guard around the heat source to protect chicks from the heat source.
3. Hang 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 at least 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.

On Arrival of chicks up to 1st week

1. Observe strict sanitation during the off 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 at $33\text{--}34^{\circ}\text{C}$.
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°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°C as chicks develop feathers.
2. Remove the brooder guards completely.
3. Start ventilation at a low rate when atmospheric conditions are favorable.
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°C or even lower than this up to 25°C .
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/M² 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 mash 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 stocking rate of the poultry house should be 9 – 12 birds per meter 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

- Should be free from defects like lameness etc.
- It should be of good colour.
- It should be able to mature sexually early.
- It should have a high laying rate.
- It should not have pauses in egg laying.
- It should be non broodiness.
- It should produce eggs with no abnormalities.
- It should be able to lay eggs for along period of time.
- Should be able to produce good quality chicks.
- Should have a good body size incase broilers
- Should have a rapid growth rate.
- Eggs produced should have high hatchability.
- It should produce chicks with low mortality
- It should be early feathering to reduce the chances of cannibalism.

Factors to consider when planning a vaccination programme for birds.

❖ Age of the bird

Some vaccines are administered to day old chicks e.g. new cattle diseases or after a week.

❖ Genetic resistance of the flock.

If a flock is resistant to a certain disease naturally then vaccination may not be needed.

❖ Health status of the bird.

Vaccines should be administered to healthy birds not sick ones since it may not serve the purpose.

❖ **Feeding and management practices followed.**

The birds should be given enough food after vaccination to reduce on stress

❖ **Methods of storage and available facilities.**

Vaccines should be stored properly under cold conditions

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

Sow; This is a female pig, which has already farrowed

Boar; It's a male mature pig.

Gilt; A young female pig, which has not yet farrowed.

Piglet The young of a pig [newly born pigs]

Farrowing; The act of giving birth in pigs.

Runt; The last born among piglets.

Farrowing pen; This is a special place where pigs farrow from

Pigsty; This is a house where pigs stay

Pork; Fresh meat from pigs

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 compared to other animals

- ❖ 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.
- ❖ Little initial capital is required as compared to dairying and fish farming.
- ❖ They consume most of the food remains reducing wastage of feeds on the farm and lowering feed costs.
- ❖ Pigs grow very fast which enables the farmer to get income in a short time when sold.
- ❖ It is adapted to specialized and diversified farming system
- ❖ They produce high quality manure which can be used in the gardens.
- ❖ Pig rearing creates extra employment for the family and the population especially in places with established pig industries.
- ❖ Pigs produce hard fat that can be used in the manufacture of soap.
- ❖ Pork is easily marketable
- ❖ Pigs are highly prolific which increases profits faster

Factors to consider before starting a pig enterprise

Type of breed

The breed chosen should be the one needed in the market and one adopted with the environment

Food supply

A constant supply of feeds is necessary since pigs quickly respond to inadequate feeding.

Capital

This is needed for purchasing the breeding stock, constructing pig houses, buying feeds etc.

Labour

Skilled Labour is required for proper carrying out of management practices like feeding pregnancy diagnosis and gilt, removing chick.

Housing

Good housing improves pig production hence it should be put into consideration.

Transport facilities

There must be reliable transport in the area from breeding centers to the market

Market

There must be ready market for the animals and their product to reduce losses.

Economy of production

Large scale production requires high initial capital therefore a farmer must be ready to meet it.

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

- ❖ Diseases serious diseases like swine fever / hog cholera has caused serious losses to farmers in the pig industry.
- ❖ Pigs are non ruminant hence compete with man for the little food available.

- ❖ Social beliefs. A number of societies in Uganda look down at a pig as a an unclean animal therefore they cannot rear or eat products from the animal.
- ❖ Have a vice of uprooting plants and destroying farm structures which makes their rearing expensive.
- ❖ Pig production requires a special kind of fence which may be expensive for most farmers.
- ❖ Inadequate organized market. Most of the pork / pig butchers are located in restricted places which makes marketing difficult.
- ❖ Poor breeds of pigs. Most of the breeds being kept are of poor quality and hence they are of low production.
- ❖ 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

2. GILT /SOW

- Should have well developed feet to enable her feed the litter even when standing.
- It should have good 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 at least 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 at least 8 piglets per farrow
- Should produce piglets with a high growth rate.

CARE FOR A PREGNANT PIG

- Feeding the sow or gilt should be given a feeds/ sow and weaner meal which are 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:

- ❖ The sow/ gilt becomes restless
- ❖ Presence of milk with in teats 12 – 24 hrs before farrowing
- ❖ Enlarged teats of the gilt or sow
- ❖ The vulva becomes swollen and enlarged.
- ❖ Muscles on either side of the tail slacken
- ❖ The sow prepares a nest from the dry grass.
- ❖ Arching of the sow's back.

Preparation for farrowing

- Clean and disinfect the farrowing pen
- Wash and disinfect the pregnant animal
- Treat the animal against internal parasites
- Move the animal to the farrowing pen
- Secure the animals feed a day before farrowing
- Provide heat in the farrowing creep area
- Provide clean beddings

MANAGEMENT OF PIGLETS FROM BIRTH TO WEANING

Feeding

- Piglets should be left with the mother to ensure that they take colostrum which is important to their bodies.
- They should be provided with feeds rich in proteins and carbohydrates [creep feed] in a special place only accessible by piglets [creep]
- Clean water should be provided to the piglets at all times.

Control of piglet's anemia

Piglets should be given an iron injection or anthill soil rich in iron.

Identification

Two main methods are used in the identification i.e. ear notching and ear tattooing.

Teeth clipping/ removal of cheek teeth

The sharp canines should be removed since they become dangerous at a later stage to the managers

Deworming

The piglets are more prone to internal worms like liver-fluke, tape worms and round worms. They should be dewormed early to ensure fast growth.

Castration

The male piglets that are not going to participate in breeding should be castrated at about 2 weeks of age

Vaccination

The piglets can be vaccinated against killer diseases like foot and mouth etc.

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 At least 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 to 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 outbreaks 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

Automatic feeders

This is where feeds are provided to pigs in their stores by a computerized system

Trough feeding

Here feeds are given in troughs.

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.

APICULTURE

The science and art of studying and looking after bees.

Advantages of raising bees /Apiculture

- It requires less space to raise bees
- Requires low labour
- Initial costs are slightly lower
- Maintenance costs are low
- Can improve crop production through pollination
- Can be easily integrated with arable farming
- Bee keeping materials can be obtained locally.
- There is ready market for bee products locally and internationally

Importance of bee farming

- Provides honey with nutritional and medicinal value
- Can pollinate crops which increases crop yields
- Bees produce wax used in making candles
- Provide propolis which has antiseptic value
- Honey can be fermented to make wine
- Bee venom can boost the immune system
- Pollen can be used in making royal jelly

Terms used in bee farming

- **Absconding** – the act of bees leaving a hive after disturbance.
- **Apiarist** – A bee keeper
- **Apiary** – Group of bee colonies kept in one location.
- **Baiting** – The act of attracting bees to colonize a hive by providing dummy hive.
- **Bee escape** - a device that lets bees pass in only one direction for removal of a comb built between and attached to other combs.
- **Brace comb** – section of a comb built between and attached to other combs
- **Brood**. Early stages of bee larvae in a comb before emerging as adult bees
- **Brood comb**. Wax comb from brood chamber of hive containing brood.
- **Burr comb**. Comb built out of place between movable frames or between the hive bodies.
- **Capped honey** - Cells full of honey, closed or capped with bees wax.
- **Castes** – The three types of bees i.e. queen, drone and workers in a colony.
- **Cell** - six sided hexagonal compartment of a comb, used to raise a brood or store honey and pollen.
- **Chunk honey**. A jar of honey containing both liquid honey and piece of comb with honey.
- **Colony**. A group of worker bees, one queen and several drones.
- **Comb honey**. Honey marketed and eaten in combs.
- **Dearth period**. period when there is little or no nectar and pollen for bees to forage
- **Extractor**. A machine that removes honey from combs.
- **Field bees**. Mature bees that can fly out of a hive to collect pollen and nectar, water and flour.
- **Field force**. Ability of bee colonies to collect nectar.
- **Forage**. Any kind of vegetation that acts as flower source to bees.
- **Foragers**. Worker bees that collect nectar, pollen and water from the field.
- **Grafting**. Transfer of young larvae from worker cells to queen cups
- **Hive**. It's the home of bees.
- **Hive stand**. A device that elevates the bottom board of a hive up off the ground.
- **Honey bee**. Genus Apis family Apidae order hymenoptera.
- **Honey comb**. Cells of wax made by bees to store honey, colon and larvae.
- **Honey flow**. A period when bees are collecting nectar from plant in big amounts
- **Honey house**. Shelter in which bee hives are kept
- **Langstroth**. Type of hive

- **Laying worker.** Worker bees which lay unfertilized eggs producing drones.
- **Mating flight.** A flight of a virgin queen during which she mates with drones high in air.
- **Mead.** Ancient name of wine made with honey.
- **Migratory bee keeping.** Movement of hives from one area to another to take advantage of honey flows from different crops.
- **Nucleus.** A small colony of bees resulting from colony division.
- **Nurse bees.** Adult bees that feed the larvae and perform other tasks in the hive.
- **Package bees.** A quantity of bees with or without a queen shipped from one place to another to start or boost colonies.
- **Pheromones.** Chemicals secreted by bees to convey information to other bees.
- **Play flight** -short orientation flight taken by young bees in large numbers.
- **Pollen trap.** Device that forces bees entering a hive to walk through a mesh that removes pollen into the tray.
- **Queen.** Sexually developed female bee that gives birth to bees in a colony.
- **Queen cell** -A special cell on a comb built purposely for raising a new queen.
- **Queen excluder**- a device in a hive that stops the drones and queen from accessing some area or place.
- **Queen right:** a colony of bees with a properly functioning queen.
- **Requeening.** The practice of introducing a new queen in an old colony to replace the old unproductive queen.
- **Royal jelly.** Glandular secretion of young worker bees used to feed the queen and young brood.
- **Robbing.** Bees that steal honey from other hives.
- **Scout bees.** Worker bees searching for nectar
- **Sealed brood.** Brood in pupal stage with cells sealed.
- **Skip** - is a bee hive of straw and dome - shaped lacking movable frames.
- **Swarming.** It's when a colony or part of a colony decides to leave a hive with or without a queen.
- **Sugar syrup** is a liquid substance made from 50% sugar and 50% water for supplementary feeding of bees.
- **Super;** A special place in a langstroth hive in which honey is produced.
- **Supersedure.** A situation when the old queen becomes unproductive to allow workers create a new queen.
- **Surplus queen.** Excess amount above that amount needed.
- **Un capping knife.** Knife used to remove honey cell caps so that honey can be extracted.
- **Wild bees.** Any insects that provide their nests with pollen but do not store surplus honey
- **Winter cluster** -Closely packed colony of bees in cold weather.
- **Worker bee.** Sexually (sterile) undeveloped female bee.

Bee species

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Domesticated bees are of two species.

- **Apis cerana (South East Africa)**
- **Apis mellifera (world wide)**
- Apis dorsata (large bees of Asia forming air suspended lives)
- Apis laboriosa
- Apis Florea

Domesticated species are two i.e. **Apis cerana and Apis mellifera.**

Bee colony members or castes

Queen

- fertile female that lays eggs
- Largest in sizes of the three castes
- Reared in a special cell that is suspended vertically
- She is only one in a hive and fiercely protected.

Drone

- They are males in a colony
- They are large and heavier than the workers
- They have no sting
- They are produced from unfertilized eggs
- They mate with the queen.

Workers

- Sterile female
- Smallest of all the three castes
- Perform most of the duties in a hive like tending to brood, guarding the nest, foraging for nectar, producing honey, propolis, and collecting pollen.

Prerequisites for apiculture

- Suitable site for apiary (hives)
- Presence of good Bee hives
- Bee harvesting gear
- Food supplements
- Adequate skills in apiculture

Selecting a good site for an apiary

- It should be near a water source
- Should be away from noisy place
- Should be near food source (trees that produce flowers)
- Should be away from a flooding area
- Should be away from strong winds
- Should be away from smoke and fire areas

- Should be free from bee predators
- Should have a good shade

Swarming

It's when a swarm (group of bees with one or more queens) leave a colony. Absconding is when the entire colony leaves a hive.

Causes of swarming

- Develop merit of new queens in presence of the old
- When the queen is infertile
- Overcrowding in a hive

Causes of absconding

- Damage to the brood
- Over heating of a hive
- Attack of bees by predators
- Absence of food within the environment
- Overcrowding in a hive
- High humidity in a hive
- Excessive creating of combs by rain.

Types of Bee hives

The type of a hive to be used by any farmer will depend on the following:-

- Capital available
- Scale of production
- Knowledge and Skills of the farmer
- Availability of materials for building hives
- Prevailing environmental conditions
- Environmental conditions of the place

Types of hives

- Fixed comb hives
- Removable comb hives with top bars
- Removable comb hives with frames

Fixed comb hives

These have opening at two ends or one end but do not allow removal of combs separately. They are mainly the traditional hives and can be made from;

- Tree bark
- Hollow tree stem
- A clay or earth pot
- Metal container
- Circular basket covered with polythene paper

Advantages of fixed comb hives

- They are cheap to buy
- They are easy to make
- They are not easily attacked by ants
- The colony is not constantly disturbed by the bee keeper

Disadvantages of fixed comb hives

- The colony cannot be inspected
- Combs with brood are easily damaged
- It's difficult to control swarming
- It's difficult to replace a queen
- Poor quality honey may be got due to harvesting the broods
- have low average yield of honey i.e. 6 to 10 kg of honey per hive per year

Removable comb hive with top bar

These are hives used for managing *Apis mellifera* mainly e.g. Kenya top bar hives and Johnson hive.

Advantages of top bar hives or removable comb hives with top bar.

- They easily allow inspection of colony development
- Honey combs can be easily removed without damaging the brood
- Honey quality is good because no brood is harvested
- Queen excluder can be easily introduced to improve quality of honey
- Contamination of honey by dead bees is easily avoided
- Mass killing of bees is reduced since brood combs are not removed
- They can be made with readily available materials.
- Good honey yield between 20 to 40 kg per hive per year

Disadvantages

- They are more expensive to buy than the fixed comb hives
- They are difficult to make
- They require more materials to make
- Colony can be disturbed constantly during inspection
- Honey combs can be easily broken during removal
- Combs with brood are not separated from those with honey.

Removable, comb hives with frames. Examples of such hives are; WBC, Langstroth, Dadant, East African long hives.

Advantages

- Combs with brood are easily separated from those with honey
- Combs can be removed from frames without breaking it
- Hives can be transported for long distances without breaking combs

- Honey can be extracted from combs without damaging it using a centrifugal honey extractor
- Produces more honey than the other types as wax collection by bees is limited.
- Very good honey yield between 50 to 60 kg per hive per year

Disadvantages

- They are very expensive to buy
- They require a lot of materials to make
- Sealing of honey combs take long

Management of bees

The management of bees may have the following practice that will ensure production of honey that has good quality and quantity. The practices that are crucial to high production are:-

- Feeding
- Parasite control
- Disease control
- Providing hives
- Catching or swarms
- Clearing an apiary
- Hive baiting
- Colony inspection
- Establishing forage
- Catching the queen
- Requeening
- Dividing a colony
- Uniting colonies
- Harvesting honey

Feeding

This supports the productivity of bees more especially during the dearth period when there is limited forage. Feeding bees may involve the following:-

1. Provide sweet food waste in water near the apiary
2. Plant nectar source plants near the apiary e.g. Acacia, Rice, bottle brush, Calliandra, Citrus, Mango, Coffee and clover, beans, banana, maize, sunflower
3. Provide water more especially during the dry period in small dishes where bees cant drown

Parasite control

Bees can be attacked by a number of pests and some are predators. The common pests are wax moths, ants, wasps, spiders, mice, rats, hive beetles, toads, birds, termites, monkeys, chimps, honey, badger, man.

Pest	Damage done	Control
Ants	- Eat nectar - Eat honey - Eat bees and brood	- Grease the hive stands and wire - Apply oil on hive stands - Burn the ants - Keep the apiary clean
Wax moths	- Feed on wax used by bees to make combs	- Build your colonies to be strong - Remove infected wax from hive - Remove old un used combs from a hive
- Birds	- Capture bees and eat it	- Set up a good apiary structure to protect bees - Scare away birds using nets around the apiary
- Wasps and spiders	- Attack and eat worker bees	- Remove webs and nests for wasps and spiders from apiary area.
- Mice and rats	- Makes nests in hives disrupting bees - Urinate in hives which repels bees	- Removal nests from hives - Kill the rodents - Hang hives on wires that cannot be climbed by rats and mice
- Hive beetles	- Eat honey and pollen	- Smoke hive with tobacco leaves - Grease the hives and stands Site hive at good height - grease the hives and stands

- Toads	- Capture and swallow bees	- Inspect hives constantly and kill toads around - site the hives at good heights
- Termites	- Destroy hives by eating wood	- kill termites in mounds - dig mounds around apiary and capture queens - treat stands using insecticides
- Monkey, chimps and honey badger	- Destroy hives - Eat honey combs, brood and bees	Make a fence around the apiary Make strong hives that cannot be easily broken into Wind a wire around the hive lid to keep it firmly

Disease management

Bees are attacked by protozoa, bacteria, fungus and viruses causing several diseases. The common diseases are;

- Varroasis
- American foul brood
- Chalk brood
- Nosema

1. Varroasis.

Its caused by a virus transmitted by parasitic bee mite (*Varroa jacobsonii*) or *Varroa destructor*. It attacks adult bees and brood.

Signs

- Low ability to feed the brood by adults
- Loss of condition
- Shorter life span
- Reduced flight per day or reduced activity
- Bees carry less nectar and pollen

- Bees die after leaving the hive.

Treatment

- Use synthetic chemical against mites e.g. biocides like a pitol, Amitraz, Apistan,(but these cause cancer)
- Treat using lactic acid, etheric oils and natural camphors
- Use biotechnical treatment
- Use formic and oxalic acids against mites in colonies without brood
- Remove drone broods whenever possible

2. American foul brood (AFB)

It's caused by a bacteria Bacillus larvae

Signs

- Sunken perforated brood cell capping
- Only young bees are susceptible

Treatment

- Isolated the colony from other hives
- Affected frames should be burnt to avoid robber bees from carrying the spores to other colonies
- Mix Terramycin with powdered sugar and provide to the bees at the end of top bars.
- Always replace the old black combs with new ones.

3. Chalk brood

It's caused by a fungus called *Ascosphaera apis*. Common signs are:-

- Presence of mummies of bee larvae in cells of brood nest in front of the hive entrance and bottom board.

Fungus growth is encouraged by

- Humidity weakness of the colony.
- High humidity in a hive may be caused by:-
- High rainfall amounts
- Humid interior of hives (leaking hives)
- Placing hives in humid areas
- Narrow flight openings.

Weak colonies are caused by;

- Disruption of balance between brood and adult bees
- An old queen
- Diseases

Prevention

- Provide good scope for ventilation and a wide opening flight
- Ensure hives are leak proof
- Raise hives atleast 0.5m above the ground.
- Work only with strong colonies
- Unite weak colonies with others that are strong
- Regularly renew old colonies

4. Nosema

It's caused by a protozoa nosema apis and only affects Apis mellifera.

It attacks intestines of adult bees.

Signs

- Diarrhoea in adult bees
- Low life span of infected eggs
- Low honey harvest.

Prevention

- Choose an apiary site that is well ventilated.
- Provide enough pollen and food stores
- Regularly renew combs
- Scrub the bottom board with disinfectant like soda water.
- Fumigate bee keeping equipment and empty combs using acetic acid.

Treatment

- Feed bees sugar syrup (2 to 1) with a dose of 30 mg active component fumagillin per litre
- Feed bees with decontaminated pollen soya flour
- Melt down the contaminated combs and decontaminate the equipment.

5. Providing hives

Select a good site or apiary site where the hives are placed. The hives that are provided should have the following features:-

- Should be clean
- Should have a good ventilation
- Should be leak proof
- Should be of good size
- Should be made from non poisonous materials
- Should have enough flight entries
- Should have handles for easy carrying
- Should be simple and easy to use.

Selecting a site for placing hives

- Should be free from bee predator that can eat bees
- Should have a good shade to ensure favourable hive temperature
- Should be quiet to reduce disturbance to bees
- Should be free from other livestock to reduce risk of injury to either side
- Should be near a water source ensure that bees have enough access to water
- Should be near vegetation or flowers which is a good source of nectar
- Should be well sheltered from strong winds that can destroy hives
- Should be free from flooding that destroys hives
- Should have low humidity to protect bees from fungal infections

6. Baiting a swarm

- Take a small hive (bait hive) that has ever been inhabited by bees.
- Place the hive in a good place where bees can easily access it.
- Protect the hive from strong winds
- As soon as the bees enter the hive, they should be taken to Apiary the same night.
- Baiting should be done during the swarming season (beginning of the dry season)

7. Capturing a swarm

- Look for a swarm of bees clustering on a branch or where it can be easily caught
- Spray the bees with sugar syrup to wet their wings. This makes it heavy and concentrated on licking the sugar so that they cannot fly.
- Cover the swarm into a light, and well ventilated container that can be easily carried.
- Shake the swarm into the container and cover it.
- Identify the queen and confine her in a match box or cage.
- Pin the queen cage in the upper part of the container with bees.
- Leave the container in cool shade covered with a damp cloth till evening.
- Carry the bees and place it together with the queen cage into a well prepared hive.
- Release the queen from the cage after two days.

NB: Handle the bees with care to prevent absconding

8. Cleaning the Apiary

- Remove bushes from the apiary to encourage a good view of the apiary for security
- Any habitat for parasites should be destroyed to reduce or control damage to the hives and colony.

9. Colony inspection

This is important because it;

- Ensures that the hive is clean
- Pests are put under control

- Allows you determine strength of your colonies
- Allows for re-allocation of hives
- Facilitates identification and treatment of diseases.

During inspection, the following are checked:-

- Bee aggressiveness
- Activity of the queen
- Presence of queen cells
- Presence of honey and pollen
- Old brood combs and black combs
- Brood pattern
- Disease and pest signs
- Sealed and unsealed brood
- Surplus sealed honey

10. **Establishing forage**

The shorter the distance between the forage and hive the more nectar, pollen and water obtained plant nectar source near the hive source.

The major sources of nectar for bees are Acacia, rice, calliandra, citrus, mango, coffee, clover, maize, beans, matooke and eucalyptus.

11. **Catching the queen**

The queen is caught in order to find out its activeness, age and productivity

Once its discovered that the queen is not active then, she should be captured and killed and requeening done.

12. **Requeening**

This is done by killing the old queen and introducing a young queen into an old colony.

This well improves the strength and productivity requeening should be done every after two to three years. Requeening can be done in the following ways:-

- (i) **Grafting.** 1 to 2 day old eggs are put in queen jelly so that they are fed royal jelly. After developing into queen, they are introduced into a hive and the old queen eliminated.
- (ii) **Doolittle method.** It involves swaping queen broods from one hive with another that has a failing queen. This allows a new queen to a rise so that the old one can be eliminated.
- (iii) **Supercedure.** Encouraging a colony to raise her own queen. The old queen is killed so that worker bees select a young larvae from a comb and feed it on royal jelly to become queens.

The first queen to emerge will kill other queens.

13. Colony division

This is done to increase apiary size and production. Its done when bees are getting ready to swarm or after the honey flow .

Presence of queen cells in hive shows that they are about to swarm.

Steps to follow

- Choose a productive, less aggressive colony with brood, eggs, pollen and honey
- Prepare a new empty hive and your bee keeping equipment
- Smoke the colonized hive and select a comb with queen cells
- Transfer the comb with old queen into the new hive leaving developing queen cells into the old hive
- Also transfer one or two combs with sealed brood and a little unsealed brood plus one or two combs of honey and pollen.
- Include bees on all the combs you transfer and brush into the new hive
- Move the new hive to a site at least 10 metres from old site.
- The new queen will hatch out in the old colony and this will become a new colony
- Feed the bees in the new hive

14. Colony unification

This aims at strengthening colonies by uniting two weak colonies to form one that is strong.

A colony can produce surplus honey only when its strong.

Procedure

- Smoke both hives thoroughly so that their familiar smells are covered.
- Dust them with flour or spray with sugar syrup to prevent bees from fighting
- Transfer all the top bars with combs and bees together into one hive
- Alternate combs from the different colonies and you do so until all the brood combs are united and then add the honey combs
- Close the hive and leave, the united colony undisturbed for the next few days.

15. Harvesting

- Good quality honey can fetch a high price

Procedure of harvesting

- Light the smoker with some burning charcoal and some, dry farm materials
- Wear the bee keeping uniform (bee suit, bee brush, hive tool, gumboots and gloves)
- Approach the hive and smoke inside the entrance holes 2 – 3 short puffs to disarm the guard bees
- Smoke around the hive if bees are emerging to disorientate them.

- Start from the back by lifting a few top bars
- Smoke back the bees that emerge from the opening
- Smoke inside the hive from the back pushing the colony inside from the rear to the front
- Use a cloth to cover the open hive to keep it dark inside
- Tap each top bar to find out whether it has a honey comb (hollow sound indicates empty top bar while dense sound indicates presence of honey comb)
- Harvest combs that are at least two thirds capped or sealed full of honey
- Lift out combs holding them vertically from the top bar so they do not break under the weight of honey.
- Cut away the light coloured combs leaving about 1cm of comb for the bees to use to rebuild a new honey comb.
- Leave the combs with brood and pollen and some honey combs for the bees
- Return the top bars into place
- Place the honey combs into a clean re – sealable bucket that can be closed to keep away robbing bees.
- Carry a second bucket for substandard combs (old dark combs) to clean the hive
- Return the hive to its normal state after harvesting

Precautions

- Honey should not be harvested during wet weather since its hygroscopic
- Harvest in the cool early hours of the day when bees have gone out
- Do not work at night to avoid harvesting poor quality honey
- Do not use too much smoke to stop tainting honey with its smell
- Put honey combs in a clean container.

Physical properties of honey

- Has a high viscosity
- Has high density (specific gravity)
- Has low surface tension
- Its highly hygroscopic
- Colour varies from clear and colourless to dark amber or black
- Has low thermal conductivity
- Crystallizes at normal storage temperature
- Ferments when moisture concentration is high

Uses of honey

- Eaten as food
- Takes away fatigue and improves sexual power
- Mixed with bread and milk products
- Helps in recovery from alcohol intoxication

- Cures a number of diseases.

FISH FARMING

Introduction

Fish farming is the rearing or growing of fish under controlled conditions and structures such as tanks, ponds, cages, pens or dam for home consumption or selling. It is a form of aquaculture; the growing of plant and animal life in water, such as crocodiles, frogs, oyster, seaweed and even rice. Fish culture involves domestication of fish in the wild state so that fish is partly or wholly managed by the farmer. The farmer provides partly or completely the necessary conditions required for fish to grow. Fish is reared in ponds, dams, raceways, tanks, cages and aquariums the kind of facility constructed will depend on the size of the farm, drainage pattern, capital available and the type of fish farming program to be followed.

COMMON TERMS USED IN FISH FARMING

1. **Aquaculture**; it is also known as aqua farming, it is the controlled growth of aquatic species.
2. **Pisciculture**; aquaculture practice involving finned fish
3. **Extensive aquaculture**; managed aquaculture dependent on local natural setting such as a pond .
4. **Intensive aquaculture**; managed aquaculture controlled through human engineered means, such as managing water quality and food sources.
5. **Fish farm**; location used to grow population of aquatic organisms, primary species.
6. **Fish hatchery**; one form of fish managed with intentions of resupplying native wild populations in natural environments
7. **Water quality**; this is the characteristics of water such as water temperature and contamination which define its ability to sustain life and its purity from chemicals.
8. **Culture tanks**; artificial holding areas used to rear fish farm stock.
9. **Fish husbandry**; the breeding and rearing of fish for a variety of reasons.
10. **In vitro fertilisation**; artificially fertilising fish eggs in a laboratory setting.
11. **Fish meal**; commercially processed food used in fish farming as a source of protein for fish.
12. **Fry**; developmental stage of fish immediately after the larvae stage at an age of less than a week.
13. **Fingerling**; developmental stage of fish following the fry stage and continuing into first three to four months of life.
14. **Yearling**; developmental stage of fish following the fingerling stage and lasting until approximately one year of age
15. **Brood stock**; fish of particular species which are raised for reproduction purposes.
16. **Fish kill**; description of the number of fish stock to die in specific period of time.
17. **Contaminants**; both natural and artificial materials usually of high concentration harmful to the health of fish

THE CRITERIA OF SELECTING A GOOD SITE FOR FISH PONDS

- i. The water source; quality and quantity of water must be relatively unlimited. Little and seasonal water is difficult to manage for fish production.

- ii. The soils must be impervious to water (do not allow water to drain away).
 - iii. Pond water should fill and drain by gravity. It is expensive to pump water in Or out of the pond.
 - iv. Ponds should be above the water table (i.e. water should not seep from the Bottom). Otherwise it is difficult to drain.
 - v. The farm should be accessible to markets and supplies (good road)
 - vi. Ponds should be large enough (from 20m x 50m to more than 2 hectares)
For commercial fish production. Larger ponds are less costly to build per Square metre but require large equipment to operate.
 - vii. Rectangular ponds are easier to manage
 - viii. The average pond water depth of 1.5m is recommended but the pond bottom should not be flat. The shallow end should be 0.5m – 1.0m and the deeper end should be 1.0m to 1.7m.
 - x. The dyke height should be within 30cm to 50cm above the pond water level. The dyke is the space surrounding the pond or between two ponds
 - xii. The dyke should be protected from erosion (by compacting hard and by planting grass cover
 - xiii. The open land space adjacent to the ponds should be wide enough to allow walking in or sufficient space for vehicles/tractors.
- Other factors include security of the place.

Fish farming is the most popular and commonest form of aquaculture, resembling crop farming and animal husbandry in the following ways;

- i) Like crop farming and animal husbandry, it also requires land for the construction of ponds, tanks and raceways.
- ii) Management procedures such as use of manures, fertilizers, weed killer and pests and diseases control which are practiced in crop farming are also applied in fish farming to increase productivity of the fish ponds.
- iii) Involves harvesting of mature fish and processing which are carried and also practiced in crops.

ADVANTAGES OF FISH FARMING ENTERPRISE

- Requires less space to practice.
- Can easily be integrated with other enterprises like poultry and piggery.
- Requires less labour to run.
- Has low maintenance costs
- Fish products have ready market.
- Fish can adapt to a wide range of fish ponds
- Fish takes a short time to mature thus bringing quick returns
- Fish is highly prolific hence brings high profits

Benefits of fish farming/ importance of fish farming

- i) Prevents over reliance and depletion of fish in the natural water bodies such as lakes.
- ii) It is a form of diversification of farming enterprises.

- iii) Fish provides food, employment, income and foreign exchange earnings.
- iv) Since fish farming can be done on marginal lands, it allows utilization of useless parts of the farm such as water logged low-lands and swamps.
- v) Due to the high quality fresh products from fish, fish has high demand in the market.
- vi) Harvesting is easy and can be done at any time. This ensures steady supply of fish to markets.
- vii) Fish farming may provide a compensation for the diminishing fish catches from natural enemies.
- viii) Fish growth can be regulated by giving extra nutritious feeds and safely from natural enemies.
- ix) Fish is less affected by pests and diseases when compared with other livestock.
- x) On a mixed farm, it provides forward and backward linkages, and this ensures proper utilization of farm resources.
- xi) It is cheaper than dairy or beef rearing since fish can feed on cheap feeds comprising mainly of farm wastes.

Factors limiting fish farming in the East Africa

- i) Inadequate research; little attention is given to research in aquaculture especially to fish species of high economic value eg Nile perch. To date most of the research work has been targeted at the subsistence culture of tilapia (*Oreochromis niloticus*) and sometimes catfish (*Clarias gariepinus*), common carp (*Cyprinus carpio*).
- ii) Limited experience among farmers, fish farming is a recent phenomenon in agriculture and many people in East Africa lack experience in rearing of fish. Even those few with experience can only do with only few species of fish such as tilapia and carp.
- iii) High pollution of the environment.
- iv) Poor fish seed quality
- v) Inefficient equipment
- vi) Low technology
- vii) Global warming
- viii) Unfavourable legal aspects which do not accept small fish in the market.
- ix) Competition with fish from natural water bodies; plenty of free fish from natural water bodies
- x) Inadequate fish seed
- xi) Strict environment regulatory laws that prohibit farming in swamps
- xii) Poor storage and marketing facilities.
- xiii) Cultural beliefs which prohibit consumption of fish.
- xiv) Inadequate quality fish feeds in the market.
- xv) Inadequate quality land and waters

Table 01 fish species of commercial value to farmers

Abbreviations: U-Uganda, T-Tanzania and K-Kenya

Vernacular Name	Common Name	Scientific Name	Features
Mputa (U) Sangara (T) Mbuta (K)	Nile perch Family: Centropomidae	Latesniloticus Very large fish The dorsal fins almost completely divided into two parts by deep notch	• Largest fish in East Africa • Requires deep water • Water must be clear • It is predatory
Ngege (UKT) Sato (T) Perege (T)	Tilapia fish Family: Cichlidae	Oreochromisniloticus (wavy caudal fin bars) and Oreochromisleucostictus (Spotted body)	• Feeds on vegetation • Prefers shallow waters with good aquatic weed cover
Male(U) Mumi(K) Kambale(T)	Mud fish, Barbel, Cat fish Family: Clariidae	Clariasgariepinus Dark grayish/black above and creamy white yellow below Has tough upper head surface Has two pairs of barbels on the head	• Occur in marginal swamps and shallow waters • It is predatory
Nkolongo or Nkumenye (U) Okoko (K) Gogogo or Ngogo (T)	Cat fish Family: Machokidae	Synodontisafrofisceri and Synocontis victoria Have branched mandibular barbels. The body is silver grey with dark spots	• Occur in marginal swamps and shallow waters
Mamba (U,T) Kamongo (T,K)	Lung fish Family: protopteridae	Protopterusathiopticus Has branched mandibular barbels. The body is silver- grey with dark spots.	• It has simple lungs and can breathe air because of this it can live in water with little oxygen as in shallow inshore water and swamps
Semutundu(U) Mbofu (T) Sew (K)	Cat fish Family: Bagriidae	Bagrusdocmac Has scaleless body and possesses a long adipose dorsal fin	• Can grow well in both deep and shallow ponds. • Prefer free flowing water
Ngege (UKT) Sato (T) Sillii (K)	Tilapia Family: Cichlidae	Tilapia zillii Large of 40 cm long. Body usually has horizontal stripes crossed by vertical bars.	• Prefer shallow water with a good aquatic weed cover
Njungule (U)	Yellow perch	Percaflavescens	• Found in lakes and rivers.

	Family:	About 0.3m (1 ft) long and up to 2.3 kg. body shiny yellow with notched dorsal caudal fins	Lives concealed among vegetation or submerged tree roots. Feeds on insects larvae and other fishes
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Table 02 Other fish species of less commercial value include;

Vernacular Name	Common Name	Scientific Name	Features
Mukene (U) Dagaa (T,K,U) Omena (K)	Sardine or Silver Family: Cyprinidae	Rastrineobolaargentea	Lives in deep and shallow waters.
Kasulu (U) Mbete (T) Domodo (T) Suma (K)	Elephant – snout fish Family: mormyridae	Mormyruskannume	Lives in deep and shallow waters
Nzere (U) Membe (T) Sire (K)	Butterfish Family: Schielbeidae	Schilbemystus	Lives in deep and shallow waters

Note: It is important to know fish by their scientific names because common names can be different from one area to another. All tilapine are mouth brooder (raise their young in the mouth bucal cavity except Tilapia zillii, which is guarded species.

Characteristics of fish

Knowing the parts of fish and how healthy fish looks is vital to a fish farmer. All fish have tails and fins to help them steer through the water. They also have eyes for seeing and gills for removing oxygen and nutrients from the water. The lateral line is the sensitive part which helps fish to feel pressure, vibrations and temperature changes in the water. In some fish such as the cat fish have barbels, small projections hanging from the sides of the mouth. They help the cat fish sense its surrounding, find food and attract small fish so that it can eat them.

Fish farming systems

There are different systems used in rearing fish on the farm.

Intensive system: This aims at obtaining the highest yield from a minimum area of water. This requires heavy inputs in the form of fertilizers and pelleted feed, high-density stocking and improved management of the fish ponds or other enclosures. The yield per unit area is high. Intensive fish farming must be commercial.

Semi-intensive: In this system, the ponds or raceways are fertilized and supplemented feeds, consisting mainly of locally available materials such as kitchen wastes and brewery wastes, are supplied minimally. The yield is between those of intensive and those of extensive fish culture.

Extensive system: In this system, no supplemental feed is supplied and there is minimal fertilization. The system is characterized by low density stocking and absence of rigorous management procedures. The result is low yield generally about 50 to 200 kilo grams per ha. Many fish culture projects in East Africa, particularly fish culture in reservoirs, are in this category. Fish farming is carried in different structures including ponds, raceways, cages, pens, tanks and aquariums.

Integrated fish farming: This is a system where fish farming is practiced in combination with crop and animal husbandry. The interaction is complementary rather than competitive. Wastes

and by-products from crops and animals are used to feed fish. And fish or their by-products are used to feed animals.

Advantages of integrated fish farming

- i) It increases fish yields as a result of increased nutrient and feed input.
- ii) It provides a cost effective way of utilizing manure wastes on the farm.
- iii) Reduced dependence on the external inputs.
- iv) Increase in the overall production per unit surface area of land.
- v) Allows recycling and proper utilization of farm wastes.

Disadvantages of integrated fish farming

- i) Manure from the animals may give fish bad odor which may not be liked by consumers.
- ii) Manure in the pond may lead to increased oxygen demand.
- iii) Manure may lower the PH of the water thus reducing growth.
- iv) More labour may be needed to manage the farm.
- v) More capital is required in integrated fish farming.

Selecting fish species for culturing in the pond

- i) Adaptability to the artificial conditions of farm ponds.
- ii) High breeding and multiplication in captivity.
- iii) Ability to scavenge and feed on natural and artificial feeds available on the farm.
- iv) Faster growth rate and weight gain.
- v) High demand in the market (the species/type of fish should be liked by the consumers).
- vi) High disease and pest resistance.

Fish farming structures

The rearing structures help to confine fish within a given territory suitable for growing and even reproduction of fish. Such structures include; ponds, cages, tanks and raceways.

Ponds

A pond is a section or a structure used to hold a standing body of water that may be standing or having a limited flow. Ponds can be constructed on earthly ground or concrete and they are the most widely used structures for commercial fish farming in East Africa. Earthened ponds are the most commonly used because they are cheap, easily integrated and make use of natural feeds and water.

Ponds can be arranged differently on the farm land as either parallel, series of rosary (circular form) whose cost of construction varies depending on different factors. The pond culture system can be extensive, semi-intensive and intensive depending on the level of management, capital investment and technology involved in the production.

Types of ponds

Depending on the site, one of the following types of ponds may be constructed.

Embankment pond (levee ponds): This pond is built by construction of walls above ground level to impound water. There is no excavation of the ground. It can be built on any agricultural

land especially flat lands. This pond is difficult to fill with water but easy to drain. Pumping is needed to fill the pond.

Excavated pond: this pond is built by digging out the soil. And the soil is used to build the embankments or levees for the pond. It is easy to fill with water but difficult to drain.

Partially excavated pond with low walls (Ravine pond): In this type of pond, soil from the excavation is used to build the low walls of the ponds. The ideal site for this pond should have a slight slope so that the water supply channel can be constructed slightly above the discharge channel. In this case, pumping is neither needed for filling or emptying the pond.

Advantages of using ponds in fish culture

- i) Ponds can easily be positioned near the farmer's home to provide optimum security against theft and predatory birds and animals.
- ii) They are easy and cheap to construct.
- iii) Earthen ponds provide cheap source of food from natural food growing at the bottom.
- iv) The earth walls and bottom stop instant temperature changes of pond water.
- v) Harvesting of fish is easy.

Disadvantages of using ponds in fish culture

- i) High initial cost; the financial investment required in the setting up and operating and maintenance of the pond is comparatively high.
- ii) Pollution; Ponds especially excavated are prone to pollution carried with run off or floods during heavy rainfall.
- iii) Ponds encourage production of weeds which may prevent growth of phytoplankton and may be used as hiding places by possible predators.
- iv) Ponds are likely to encourage muddy conditions which affect growth of plankton and impair vision of the fish limiting their ability to find food.
- v) Because many ponds are commonly earthen, silting and mud accumulation at the pond bottom usually takes place.
- vi) Because most of the water is coming from the ground, the water may contain some heavy metals, low dissolved oxygen, low PH and low temperature.
- vii) More labour is required in the construction and maintenance of the pond.
- viii) Increased algal blooms; due to warm temperature and increased nitrification of the ponds, the rate of algae growth may exceed the rate of algae consumption by fish. Algal bloom can cause a considerable threat to fish in the pond because
 - The bloom can consume available oxygen either during nocturnal respiration or by increasing the biological oxygen demand if the bloom suddenly dies with the resulting suffocation of the fish.
 - Under certain conditions some algae are capable of producing specific toxins which kill fish.
 - The mat of algae covering the water surface may prevent oxygen diffusion into the pond water.

Raceways

This is a semi-closed structure made from concrete blocks or other durable material. Raceways are designed to provide water flow through the system to enable rearing much denser population of fish and fish of different species. Water moves quickly through the structure providing oxygen and flushing out metabolic wastes, particularly ammonia. Although the earthen raceways exist, majority of them are made of concrete. Though the earthen type is cheaper to build, due to high velocity and big volume of water, seepage and erosion do occur.

Advantages of using raceways

- i) The level of oxygen in the water is high.
- ii) Can be used in intensive fish farming due to accommodation of high stocking densities.
- iii) Metabolites are continuously removed.
- iv) Can be used to rear a variety of fish species.
- v) Occupies much less space than ponds.
- vi) Uses less water which is important where water is scarce or where water is pumped.

Disadvantages of using raceways

- i) Requires a lot of water and a reliable water source.
- ii) Disease organisms in one raceway can easily spread to other raceways down-stream.
- iii) Where the segments are arranged in series, metabolites may accumulate in the last segment.
- iv) Requires high investment due to increased construction and production cost.
- v) Requires high technical skills, which is sometimes limited.

Dam system

Dam culture involves the blocking of a stream or river, resulting in a large collection of water behind the blockage. The barrage can be constructed out of soil, concrete, metal or marine wood. The site selected for the dam construction should be gently sloping, with soil of high water holding capacity, free from strong winds and with reliable water supply from a stream or river.

Maintenance of the dam

- Remove excess plants
- Keep the level of water in the dam constant
- Repair any leakage in the walls, and outlet
- Cut down the vegetation near the dam to prevent the roots of the vegetation from damaging and cracking dam walls.
- Control wild fish
- Control weeds both terrestrial and aquatic weeds.
- Fertilize the dam regularly to keep the water green.
- Apply lime regularly to maintain optimum PH
- De-silting the dam regularly
- Repairing broken/leaking dam walls.

Tank system

Tank system is one of the intensive culture systems common in areas with limited fresh water. Tank can be made of concrete, fiberglass, marine plywood, metal, plastics or other hard materials free from toxic substances.

Advantages of rearing fish in tanks

- i) Easy to manage and are suitable for experiment work.
- ii) Diseases are well controlled.
- iii) Feeding and harvesting takes less time since fish are held in small space.
- iv) High stock densities are possible.
- v) It can be practiced indoors and therefore lends itself to urban farming.
- vi) It is easy to control the environment and quality of water.
- vii) Requires very small space.

Disadvantages of rearing fish in tanks

- i) Require a lot of capital investment to construct or buy tanks and to refill the tanks with water periodically and to install oxygen tanks.
- ii) There is higher risk of mortality due to disease outbreak, mechanical or electrical failure.
- iii) Easily polluted with solid waste concentrated at the bottom. This leads to increased biological oxygen demand.
- iv) Requires a lot of skills.
- v) Disease outbreak may not be easy to manipulate.

Cage system

This involves rearing of fish in cages enclosed in rivers, lakes and ponds. Cage can be circular, square or rectangular. Cages can be partially exposed or completely submerged under water. Cage should be placed where water movement is minimum and where the security for the fish is ensured.

Advantages of rearing fish in cages

- i) Requires very little maintenance and management.
- ii) Fish are protected from predators.
- iii) Allow more fish production (high stock densities)
- iv) Requires very low investment
- v) Fish suffers less from diseases
- vi) Constant water exchange inside and outside the cage provide sound environmental condition for fish which improve growth.

Disadvantages of rearing fish in cages.

- i) There is high risk of damage to the cages due to flood and high wave current
- ii) Adverse environmental changes such as pollution, extreme temperature and water level changes are dangerous to fish in cages.
- iii) High feed quality is required.

Pen system

This involves fencing off of parts of the lake, or river or lagoons and stocking it with fish. The fence prevents fish from swimming into the lake and the fish are restricted to only a limited space in the lake or rivers or lagoon.

Pond construction

Site selection

When choosing the site for pond construction, the following factors should be considered.

Topography: A gentle slope of about 2-4%. This allows the pond to be filled and drained easily under natural gravity. If the slope is too steep, it will have landslides or soils falling into the pond and the construction of the pond becomes very expensive because appropriate levels within the pond must be attained. If the site is flat, then the pond will be difficult to drain and flooding of the pond may occur during heavy rainfall.

Soil type: The soil should be fertile and firm with very high water holding capacity to be able to hold water in the pond for longer time. Soil with a lot of clay content is ideal.

Water table: The site should have a high water table, so as to reduce the cost of filling the pond.

To test the ground for water holding capacity;

- Dig about 1m deep hole.
- Fill the hole with water to the top and cover it with leaves.
- Check the water the next day, the water may have reduced due to spillage, refill the hole with water to the top and cover again with leaves. Check the water level the following day.
- If the water level is still high on the second day, then the land is suitable for pond construction and if the hole is dry then the ground is not fit for pond construction.

Water supply and quality: The site should be near a permanent water source and water of good quality. Source of water can be ground water or surface water from streams, rivers, and lakes. The water should not be saline, should not contain heavy metals and should have neutral pH. Ground water is free from dirt and other pollutants, fertilisers and pesticides. However, ground water has low oxygen levels and low temperatures.

Site accessibility: The site should be easily accessible for regular monitoring of the fish and transportation of fish.

Security: For security reasons, the site should be near sleeping houses. This allows the farmer to offer security to the fish from predators and masqueraders and those with bad intention to harm the fish.

Freedom from pollution: The site should be free from toxic residues. If the site has been used for crops, the soil should be tested for harmful chemical residues of certain pesticides that are particularly undesirable.

Cost: The cost and size of the site, land terrain and the economies of grading the land and construction.

Human activities: Human activities may have a great impact on growth of fish. Pond pollution from human wastes and chemicals residue may take place and affect fish.

Steps in construction of a pond

After satisfying the requirements for site selection, the farmer can now make a decision on the size and scale of the pond and the pond can be circular, square or rectangular. The following are steps involved in construction of a pond;

- i) Survey the land; mark the slope and find out the natural drainage pattern of the land.
- ii) Clear the site of stones, tree stumps and roots such obstacle and trash will interfere with harvesting operations and may give fish an undesirable flavor. Trees and shrubs should be cut back at least 15 feet from the pond to allow movement of feeding and harvesting equipment.
- iii) After clearing survey and stake out the slope of the dam or walls dyke. The gradient of the land will help to determine how much soil should be excavated, and the height of the wall dyke at the front of the dam can be ascertained easily.
- iv) Mark out the area where the pond and walls are to be constructed with pegs and a string. The size of the pond will depend on the fish species reared.
- v) Dig out the soil from the marked area when digging out the pond, top soil should be separated from the subsoil. The depth of the pond is usually 1.0-1.5m at the outlet and 0.5-0.8m at the inlet giving the base of the pond a slanting floor. Ensure that the floor of the pond is smooth.
- vi) Use the subsoil to build the pond walls. Compact the soil as you pile it around the banks to make a firm-stable leak-proof walls. The walls should be slanting and at least 30cm above the water level when the pond is filled. If need be reinforce the lower wall of the pond with concrete.
- vii) Fix inlet and outlet pipes within the walls to allow water to move in and out of the pond respectively. The outlet pipe should be placed at the lower end of the deepest part of the pond. Inlet and outlet pipes should be screened to stop rubbish, wild fish and frogs from entering the pond and to avoid fish from escaping from the pond. Place another pipe above the wall to drain away excess water and to prevent flooding and spill of water from the walls.
- viii) Spread the top soil that was earlier put aside over the pond walls and plant the walls with grass to prevent wall erosion by rain water.
- ix) Spread a layer of lime on the pond floor about 15 days before filling the pond with water. Lime helps to maintain the pH of the water in the pond and encourage the growth of phytoplankton and other organisms in the pond to provide food for the fish.
- x) Fill the pond with clean water after about two weeks. Water should be filled in the pond slowly so that scouring of the walls and the floor does not occur. The structure should be checked for leaks. Filling should take several days.

Maintenance of the pond

- i) Planting of the grass along the walls to stabilize the walls and prevent them from being eroded by rainfall.
- ii) Fencing of the ponds to keep away farm animals that may damage pond walls.
- iii) In case the pond was constructed on flat land prone to flooding, diversion channels must be constructed around the pond to keep away unwanted water from the pond.

- iv) Roots of heavy trees near the pond should be trimmed by trammeling to stop the roots from breaking pond walls that could lead to leakage.
- v) Some water weeds can be planted in the pond to provide oxygen, provide shelter during hot sunny days and to provide breeding ground for fish.
- vi) De-sitting of the pond regularly to maintain the pond depth.
- vii) Draining of exhausted water and refilling of the ponds with clean oxygenated water regularly.
- viii) Liming of the pond regularly to maintain optimum pH of the pond water. Optimum pH for most fish is between 6.5-9.0.
- ix) Fertilization of the pond regularly to encourage growth of algae and phytoplankton, which are the regular source of food to fish.
- x) Controlling algal bloom and weeds.
- xi) Control of predators such as snakes, toads, wild catfish, birds (heron)etc.

Routine fish management practices which increase fish yields

The following are management techniques which have been known to be effective in increasing the yield of the fish in the pond.

1. Selection of the fish culture
2. Stocking
3. Feeding
4. Control of predators
5. Water quality and quantity management
6. Pest and disease control
7. Fish sampling and sexing
8. Sorting and grading of fish
9. Harvesting and marketing of fish
10. Record keeping

Selection of fish species for culturing

This involves choosing the fish species which are suitable for culturing. The following factors should be considered when choosing fish species for culturing;

- i) Adaptability to restricted environment of the pond, tanks, cages or raceways.
- ii) High growth rate
- iii) High efficiency in utilization of feeds
- iv) Adaptation to crowded environment.
- v) High breeding ability.
- vi) High commercial value (marketability)
- vii) Resistance to stress and diseases
- viii) Availability of the fish seed readily in the area.

Stocking

Stocking is the act of placing fish into the pond. And stocking density is the total number of fish which can be stocked. Good stocking density gives good fish growth while too many fish lead to poor fish growth.

Stocking rate: This is the number of fish stocked in a pond. The larger the number of young fish stocked in a pond the higher the expected yield at harvesting. The rate can be increased by polyculture. The culture of different species of fish with different food habits, in the same pond or by stocking of different age groups of the same species provided the species has different food habits at different stages.

Factors that affect stocking rate of a pond

- i) Fish species: Some fish species require more space because of their behavior.
- ii) The rate of production e.g. low stocking rate is recommended with species which multiply very fast.
- iii) The size and weight of fish; larger fish require relatively more space than smaller fish of the same species.
- iv) Fertility of the pond and its ability to provide natural food supply.
- v) The amount of natural and supplementary feeds.
- vi) The size of the pond.
- vii) Water quality (metabolite contamination and oxygen supply)
- viii) The growth rate of the fish and the period of time the fish take to mature.
- ix) Level of management of the pond such as fertilizer application supplementary feeding.
- x) Pests and diseases.

Carrying capacity is the number of fish of the same species or different species that can be stocked in a pond for a given period of time. However, adequate carrying capacity can be limited by other factors such as oxygen supply, accumulation of waste products, availability of food, and the size of the pond and diseases.

Maintaining optimum fish population in the pond

- i) Stocking of the pond with single sex fish species.
- ii) Selling of fry to other farmers
- iii) Stock a predator with the fish to eat the young fish produced.
- iv) Early harvesting of matfarming/h.

Water quality and quantity management

pH and salinity are the two main measures of water quality. Water pH can be maintained by liming the pond regularly. Turbidity is the measure of the suspended particles in the water. Use of silt traps help prevent particles into the pond. Optimum water level is important for growth of fish. Water level in the pond may drop due to the leakage of the pond bottom and walls or at the drain pipe. Repair cracks in the wall and refill with clean water.

Liming the pond;

The physical and chemical properties of the water must be kept within tolerable limits for the fish species cultured. The optimum pH for the culture is about 6.5 – 9.0. Low pH is corrected by the addition of quick lime in the pond. Lime also calcium for growth of algae and helps to reduce diseases as well as killing undesirable organisms in the pond. Lime should be spread

onto the pond bottom while it is dry. The amount of lime needed to produce a neutral pH in the pond water depends on the soil type, pH of the soil and that of inflowing water.

Fertilizing the pond:

Periodically the pond should be fertilized by applying organic manure and / or inorganic fertilizers to increase the nutrient content of the pond water and this leads to increased phytoplankton production and in the end to increased fish yield. The major disadvantage with the use of organic fertilizers is that organic materials have high oxygen demand during decomposition and this may affect fish if applied in large quantities. Animal manures produce blooms of algae that fish cannot digest. Fertile pond water is green in colour. It contains plenty of algae, plankton and water plants.

Supplementary feeding

Fish in the pond obtain their food from the natural resources such as algae, plankton, water plants and living organisms such as snails, earthworms, and larvae of insects. However, the natural sources of food in the pond may be insufficient for fish in the pond, reducing fish yield. Supplementary feeding entails provision of food from extraneous sources to increase fish yield. Example of supplementary food for pond fish includes;

- i) Grass and leaves such as banana, cassava, and other leaves from tropical crops.
- ii) Grains and pulses such as rice mill, maize mill, brewery grains and soya bean waste.
- iii) Milling by-products such as cotton seed cake, coconut cake and ground nut cake.
- iv) Formulated diet of mixed concentrates. These are made into pellets for feeding to fish.

Fish grow most rapidly on a diet high in protein. An ideal diet can be made for fish by mixing proteins, carbohydrates and fats with the necessary vitamins and minerals. Such diets are made into pellets for easy feeding to fish

Table.....Effect of diet and feeding level on standing crop of tilapia.

Diet (Kg / ha / day)	Maximum standing crop (kg of fish / ha)
1 part cassava leaves 2 parts ground nut cake 15 50 100	960 2000 3080
1 part cassava leaves 2 parts rice waste 15 50 100	750 1150 1650

Ground nut cake has much higher protein content than rice waste. Planktivorous (plankton-eating) fish are unable to eat and digest such foods. It is important to note that fish do not have celluloses, so they can't digest cellulose. Fish do not have a gizzard and therefore they don't regulate. The food should be made as fine as possible to increase surface area.

Fish which are growing quickly eat about 3% of their body weight of a well-balanced food per day. Food should always be given at the same place each day so that fish get used to

feeding at the same time and food should be given on trays or in a feeding frame to allow the farmer to see if all the food given has been eaten or whether there is any left.

Determination of quality of feed

The quality of feed is determined by how many kilograms of feed produce 1 kg of fish if the fish is fed on that feed alone. This ratio is called the food conversion ratio (FCR) and is obtained as follows;

$$FCR = \frac{\text{total weight of feed to fish}}{\text{total increase in the weight of fish}}$$

The feed conversion ratio indicates the efficiency of the response to feeding. For example; Katwe fish farmer's cooperative harvested 5000 kg of fish from one hectare pond at the end of the year and found that they had used 7000 kg of feed to feed the fish. Calculate the feed conversion ratio for the feed

$$FCR = \frac{7000}{5000} \quad FCR = 1.4$$

This implies that for every 1.4kg of feeds consumed by fish produces 1kg of fish. The smaller the FCR the better the feed. Value above 2 is irrational.

Feeds can be fed to fish in feed trays or sprinkled over the water (if it can float). Give only the amount of feed the fish can finish within 20 to 30 minutes. Do not over feed or under feed the fish. Give feed in the mid- morning and afternoon when the temperature is not too high or too low.

Sign of over feeding

- i. Presence of feed left overs in the pond.
- ii. Plenty of phytoplankton since fish cannot consume it due to too much artificial feed.
- iii. High reproduction rate.

Signs of under feeding

- i. Clear water indicating absence of phytoplankton
- ii. Reduced rate of growth and weight gain
- iii. Reduced reproduction rate
- iv. Increase in the rate of cannibalism
- v. Starvation and death of fish

Feeding for different stages of fish development

Larvae: Newly hatched young, still bearing the yolk sac do not need external food, require oxygen and removal of physiological wastes. The yolk sac provides all the needed nutrients at this stage.

Fry: The larvae which have finished utilizing the yolk food reserves develop into fry. They have functioning alimentary canal. They should be fed with processed feeds. Feeds should have 40% proteins content in power form. The fry should be fed 5 – 10% of their body weight several times a day. At this stage, fry can be nursed in green water to provide natural food outside artificial.

Fingerling: From one week onwards, fry have developed into fingerlings. Green water nursing and supplementary feeding should be maintained for 2 – 3 months to produce 10g fingerlings. Such fingerlings can adapt new stocking habitats, grow fast and attain table size within 6 months of good management.

Table size fish: When provide with adequate balanced diet, plenty of oxygen and suitable pH, fingerlings grow very fast to reach the table size. The level of supplementary feeds should be increased to match with the increased body weights of the fish in the ponds about 35% protein, 10% oil and 55% carbohydrates will promote fast growth of fish. Fish should feed 3% of their body weight daily.

Stocking of ponds with fry: After preparing the pond and filling it with water and maintaining of the pH, and oxygen level of the pond to the required standard, fry or fingerlings can be stocked in the pond. The young fish are introduced into the pond by lowering the container in which they are in water and allowing them to swim out into the pond water voluntarily. The temperature of the pond water and that of the water in the fish container should be the same to avoid shock.

Stock manipulation and breeding control

This involves genetic selection for the desired qualities e.g. fast growth rates and good quality fresh and control of the numbers of fish in the pond by preventing breeding through production of monosex tilapia, either through the cross of two species or through sex reversal resulting from treatment with certain hormones. When fish of the same sex is stocked in a pond, there is no breeding and the fish spend much of their energy in growing, resulting into increased yield and quality fish. Good fish for breeding should be; well- formed without bruises, free from diseases and parasites, lively and active, few years old and sexually mature. Brood fish can be obtained from: natural waters, fish breeders, other pond owners and government fish farms.

Determining the sex of fish (sexing fish)

The sex of fish can be determined more easily in brood and adult fish which have developed fully. Sexing fish on the farm helps in controlling stocking rates in ponds by controlling fish breeding. For starters who are stocking their ponds for the first time and want first multiplication rate of fish, they can decide to stock ponds with more female fish.

For tilapia

The male: has only one opening the cloaca and a genital papilla. When the abdomen is gently pressed, thin watery milt (semen of fish) is released. The body is darker in colour and the tips of most fins are reddish in colour.

The female: has two openings the cloaca and the genital opening. When pressure is applied to the abdomen, milky fluid comes out. The navel is short (small). Sometimes, eggs come out when the abdomen is pressed. The body is lighter in colour and the fin tips less coloured.

For Mudfish

The male: the head and the entire body are narrower and longer in length and a genital papilla. When a gentle pressure is applied to the abdomen near the cloaca, white milt is released from the cloaca. Have longer barbels.

The female: the head and the entire body are broader and shorter in length. When the abdominal area near the cloaca is gently pressed, a clear fluid is released from the genital opening and some eggs may be released. Have shorter barbels.

Age determination

Determining the age of fish is an important management practice as it helps to provide appropriate management to fish depending on its age and it is also used to assess the efficiency of management practices applied to the fish ponds (comparing the age to the weight / size of fish). The age of fish can be estimated by referring to farm records, observing

the external features of fish, counting growth rings on the scales, weighing, measuring the size of fish.

Control of pond environment

The physical and chemical properties of the water should be kept within the tolerable limits for the fish species cultured. Oxygen level and pH must be optimum and control of poisonous substance from teaching the pond.

The pH of the pond water may fall from optimum (6.5-7.5) due to;

- Acidic rain water
- Acidic water supply into the pond
- Accumulation of metabolites in the pond
- Organic and inorganic acids release from organic and inorganic fertilizers
- Anaerobic respiration of microorganisms in the pond.

Low pH of the pond water is corrected by addition of lime in the pond and high pH is corrected by addition of ammonium sulphate to the water.

Oxygen is used by fish for respiration. The dissolved oxygen in the water is measured in milligrams per litre of water (mg/l) or parts per million (ppm) the minimum acceptable level of dissolved oxygen in water is 2 mg/l, dissolved oxygen level of above 5 mg/l is required for good growth in fish. Oxygen in the pond water comes from plants during photosynthesis and atmospheric oxygen that dissolve in the water. The signs of low oxygen levels in the water include;

- i) Fish suddenly stops feeding
- ii) Fish swims at or near the surface gasping
- iii) Dead fish with open mouth and raised gill cover
- iv) High turbidity of the water

The amount of oxygen in the pond may decrease due to;

- i) High level of respiration from fish due to over-stocking
- ii) Over fertilizing of the pond
- iii) Algal bloom which make a mat over the water surface, preventing diffusion of oxygen into the pond from the atmosphere.
- iv) Muddy or turbid condition of the pond, preventing sunlight from reaching plants under water reducing photosynthesis and eventually reducing amount of oxygen being released.
- v) Cloudy days that reduce sunlight energy and photosynthesis.
- vi) Dense vegetation in and around the pond that use atmospheric oxygen at night.
- vii) High pond temperatures which decreases the oxygen holding capacity of water.
- viii) Limited wind to stir water to increase oxygen diffusion.
- ix) Lack of fresh water flowing into the pond to replenish oxygen and to carry away metabolite.
- x) Over-staying of water in the pond for a very long time.
- xi) Oil covering the pond water. Oil film prevents oxygen diffusion into the water

Oxygen level of pond water can be increased by;

- i) Replacing old water regularly with fresh water.
- ii) Flushing in of fresh oxygenated water.
- iii) Using of aerators which splash water in the air to mix with atmospheric oxygen.
- iv) Application of only inorganic fertilizers to increase amount of plants in the pond which provide oxygen. Manures use oxygen during decomposition, thus reduces oxygen in the pond.
- v) Cleaning much of the vegetation especially on the windward side to increase stirring of water and diffusion of atmospheric oxygen into the pond water.
- vi) Allow some fresh water from a stream to continuously pass through the pond. Fresh stream water brings in oxygenated water and carries away deoxygenated water.
- vii) Introducing some water plants into the pond to provide oxygen during photosynthesis.
- viii) On a mechanized farm, artificially –made oxygen can be pumped into the pond water.
- ix) Keep only the right number of fish in the pond to prevent rapid depletion of oxygen.
- x) Keeping the level of the water in the pond at the recommended level.
- xi) Reducing muddy condition in the pond.

Control of weeds

Weeds in the pond may make harvesting of fish difficult and act as a hiding place for predators. Biological control of weeds can be affected by stocking of the ponds with vegetable-eating fish species. Herbicides such as sodium arsenite, sodium chlorate, 2,4D and dalapon, at low concentrations are useful in controlling pond weeds.

Control of diseases

The crowded nature of the pond environment is conducive for the easy spread of fish diseases. Good pond management eradicates diseases from the pond. If infection occurs, it should be treated with appropriate drugs such as malachite green, copper sulphate, dipterex and bromex.

Production of fish seed

Like in crop farming, fish farming requires good quality seed (fry or fingerlings) to use for stocking and culturing. Many fish species do not breed in captivity and this has constrained culturing of many species of fish. Currently fish seed is readily obtained from the cichlids (the tilapia group) which readily breed in captivity, while artificially induced breeding (spawning) is done in African catfish (*Clarias gariepinus*) and the common carp (*Cyprinus carpio*).

The process of seed production involves selection of brood fish, conditioning through good feeding, induction through mimicking natural stimuli or using hormones or increased water flow, spawning, hatching, rearing of larvae and fry, grading, sorting and harvesting.

Under natural conditions spawning is controlled by hormonal changes with the fish and environmental conditions such as rainfall, temperature and day length. Under culture conditions, spawning takes place in a few fish species such as tilapia. Most cultured fish species have to be induced to spawn by mimicking the natural stimuli or using hormones. Cat fish (*Claris gariepinus*) do not usually spawn in captivity. Spawning is usually artificially induced by hormonal injection of the female with pituitary extract to induce ovulation. Signs of ovulation include the softening of the belly and the belly has a shifting softness when a

hand is passed over it. Also loose eggs are exuded through the genital aperture when the belly is gently pressed.

In cat fish (*Clarias gariepinus*), the eggs are squeezed out of the female into a clean container. The male is killed and the testes removed. The semen (milt) is extracted by cutting the testes longitudinally and squeezing out semen into the eggs. Milt and egg are then mixed for about one minute to allow fertilization. The fertilized eggs are then washed to remove excess milt. The fertilized eggs are then incubated on trays made of mosquito nets held by metal or wooden frames. In order to prevent fungal infection of fertilized eggs, eggs are dipped in 1000ppm formalin for 15 minutes.

Fertilized eggs remain dark and yellowish cream (or transparent in tilapia) while unfertilized eggs are white and opaque. Also embryos can be seen making movements within the eggs in fertilized eggs towards the end of incubator.

Incubation takes place in a tank of gently flowing water. The temperature of the water should be 26 to 28° C. Time taken from fertilization to hatching is usually 48 – 72 hours depending on the water temperature and the fish species.

Fish health management

Successful fish health management begins with prevention of diseases rather than treatment. Prevention of fish diseases is achieved through good water quality management, maintaining optimum stocking rates, use of clean seeds during stocking, good feeding, and putting up good sanitary measures.

Signs of ill-health in fish

- i. Fish not eating as usual (loss of appetite)
- ii. Fish swim sluggishly and become less responded to the external stimuli.
- iii. Fish swimming on its side upside down
- iv. Fish floating on the surface gulping
- v. Impaired gills
- vi. Presence of dead or dying fish
- vii. Fish continuously rubbing against objects
- viii. Hemorrhages, ulcers, popping eye balls and swollen abdomen.

Fish predators and their control

Farmed fish can be preyed upon by fish-eating birds, wild fish e.g, catfish which may enter the pond during filling as eggs or fry. They feed on tilapia fry and eggs, frogs, Eels which feed on fry and eggs of tilapia, tadpoles, snakes, and otters, fishing bats, monitor lizards and insects such as backswimmers. These predators may be controlled by using one or a combination of the following;

- fencing off the ponds to deny entry of predators,
- poisoning of rats and predatory birds,
- liming to kill off tadpoles and insects in the water,
- use of traps for large predators,
- use of screen on the inlet pipes to deny entry of predators,
- covering the top of the ponds with nets to control birds ,
- clearing the bushes around the pond.

Harvesting of fish

The time of harvesting fish depends on the purpose for which fish is to be used. Fish can be harvested as fingerlings or fry for stocking or as table fish for food. The following are some of the methods used in harvesting fish in the pond.

Drainage of the pond water; Pond water is drained out preferred fish is then picked into basket. The pond is later on refilled with clean water.

Use of hooks; These are used for small scale farming or in sampling experiments. A hook, single or a series of hooks are baited so that when fish swallows the hook, the hook pierce and get stuck in the mouth. The method is not good because fish is wounded and does not discriminate on the size of fish.

Use of seine nets; A net of desirable size is dragged through the pond bottom to catch fish in the pond. Also the net can be suspended in water and the fish trying to pass through the mesh are trapped by their gills and entangle themselves in the net.

Procedure of using a gill net in deep waters

- i) Tie the weights at the foot-rope (bottom end of the net)
- ii) Tie the floats at the head line (top end of the net)
- iii) Fix anchors on both bottom sides of the net.
- iv) Suspend the net in water vertically for some time; a combination of weights at the bottom and floats at the top helps the net to remain upright in water.
- v) Fish are trapped when they try to force themselves through the meshes, where their gills get entangled in the net.
- vi) Lift out the anchors.
- vii) Lift out the entire net with trapped fish from the water.
- viii) Untangle fish from the net.
- ix) Remove the floats and then the weights.
- x) Leave the net to dry and then store in a cool dry place.

Procedure of using a gill net in a shallow pond

A number of people hold the net in a semicircle at one end of the pond, and then the net is hauled slowly through the pond to the other end. At the end of the pond, fish trapped in the net are removed and sorted. Large / old fish are retained for marketing and small / young fish are returned to the pond.

Harvesting fingerlings

- Harvest during cool hours of the day especially in the morning.
- Select harvesting method that will not bruise or wound the fish.
- Use a seine net to catch and lift the fish from the pond.
- Disinfect the holding equipment and water to prevent diseases.
- Excessive mudding of water should be avoided.
- The fingerlings should immediately be placed in storage facility with adequate aeration.
- Grade the fingerlings to ensure uniformity of size.

- Fingerlings should not be held out of water for more than a few seconds, because they need much oxygen than the old. Fingerlings which slip their slime or become dry are very susceptible to diseases and parasites.

Other methods used in harvesting fish include; use of traps and scoop nets. Fish poisons paralyze fish which is then caught. However, the use of poison on private or natural waters is forbidden by law because the method destroys both adult and juveniles (including larval stages) and leads to depletion of the stock. It may also be difficult to clean the poison from the pond for restocking. Also poison residues in fish can harm people who eat them. During harvesting, care must be taken to avoid excessive mudding of water as this would stress the fish remaining in the pond and retard growth.

Fish processing and preservation

When a fish has been caught and taken out of water, it must be processed as soon as possible otherwise it gets spoilt, since fresh fish deteriorates rapidly as soon as it dies. Spoilage is caused by bacterial action, and the deterioration process is speeded by the high temperatures.

Fish processing involves removal of scales, removal of viscera and gills, cleaning of fish with water and in some case removal of the skin and fleshing to obtain fish fillet. The bones and fins are processed into fish meal for feeding livestock.

Fish preservation involves treatment of processed fish to prevent spoilage and increase shelf life of fish. The methods used to preserve fish include; freezing, and chilling in ice, smoking in Chork or kiln, salting and caning.

Benefits of fish processing and preservation

- i) Prevents rapid fish spoilage (decay).
- ii) Maintains and even improves the quality of harvested fish.
- iii) Makes handling and transportation of fish easy.
- iv) In some fish species, preservation increases accessibility of the fish to consumers.
- v) Processed fish fetches higher prices than unprocessed fish.

Procedure of smoking fish using Chorkor kiln

- i) Descale fish
- ii) Split the fish open to allow deeper smoke penetration into the flesh.
- iii) Remove the stomach contents.
- iv) Wash the fish in clean water to remove blood and excess fats.
- v) Soak the fish in salt with spices added (depending on the taste of consumers).
- vi) Hang the fish and allow it to drip dry for some few hours.
- vii) Place the fish on the rack made of wire mesh. Lay the rack on the combustion chamber.
- viii) Set up the fire. The fire releases heat and smoke.
- ix) Smoke the fish for 3-4 hours at temperatures of between 30°C and 40°C. The heat from the fire dries the fish and the smoke penetrates fish flesh, causing browning and flavoring of fish. The smoke also has preserving properties.

Procedure of salting fish

- i) Descale fish.
- ii) Split the fish open to allow deeper salt penetration into the flesh.
- iii) Remove the stomach contents.
- iv) Wash the fish in clean water to remove blood and excess fats.
- v) Soak the fish in salt solution for at least four hours to allow deeper salt penetrate into the flesh.
- vi) Dry the fish in sunshine for some days depending on the weather conditions until he fish dries through to a moisture content of less than 25%.

ANIMAL NUTRITION

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 N₂ 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.

Output X price

Feeds taken X price

Gross energy efficiency; energy output of an animal per energy intake i.e.

Energy output in products

Energy taken in feeds

Net energy efficiency; the measure of real energy output in products fro feeds eaten i.e.

Energy out put in product

Energy taken in – 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 feecal nutrient. Therefore

Digestibility =
$$\frac{\text{Nutrient intake (NI)} - \text{Nutrient in feaces (NF)}}{\text{Nutrient Intake (NI)}} \times 100\%$$

=
$$\frac{\text{NI} - \text{NF}}{\text{NI}} \times 100\%$$

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.

Digestibility =
$$\frac{\text{NI} - \text{NF}}{\text{NI}} \times 100$$

=
$$\frac{500 - 150}{500} \times 100$$

$$= \frac{350-70}{5 \times 1}$$

$$= \underline{70\%}$$

Methods of determining feed digestibility

Conventional total collection

This involves giving an animal a constant daily feed intake and recording amount taken and faecal output.

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 and internal indicators which are part of the feed e.g. chromogens, ash etc.

FACTORS AFFECTING FEED DIGESTIBILITY

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.

Age of the animal

Very old and young animals have insufficient digestive systems hence show low digestibility of feeds.

Individual differences

Animals of the same species have shown differences in their digestibility of the same kind of feed as much as 25%.

Exercise

A light exercise improves digestibility of a feed while heavy exercises depress it.

Addition of molasses to animal feeds

These will improve digestibility of feeds since they contain highly digestible carbohydrates.

Type of feed

Proteins and carbohydrates are more digestible as compared to other types of feeds.

Associated effect of other feeds

Increased intake of proteins will improve digestibility of fibre.

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.

Presence of anti metabolites

Some feeds may contain anti metabolites e.g. trypsin inhibitor in raw Soya beans.

Health of the animal

Sick animals will have a low digestibility of feeds due to the abnormal physiology.

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

RATION FORMULATION

In making any ration, the following considerations should be made:-

The cost of the feed

Expensive feed stuff should always be limited in this ration since they may be uneconomical.

Availability of feeds

The feeds that make up the ration should be readily available in the environment to reduce transport costs.

The nutrient requirements of animals in consideration

If the animals under consideration need a lot of proteins the ration should answer their nutrient requirements.

The palatability of the feeds used

Feeds that are used in ration formulation must be highly palatable for animals to gain from it.

The skills of a farmer

The person formulating the ration should be highly skilled to produce what is required by the animal.

The nature of the final product

The ration made should be in a state that can be utilized by the animal.

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

Amount of maize bran needed in 500 kg (5 bags of 100kg@)

$$\text{Maize bran } \frac{24}{32} \times 500\text{kgs} = 375\text{kgs}$$

Amount of fish meal needed in 500kg

$$\text{Fish meal } \frac{08}{32} \times 500\text{kgs} = 125\text{kgs}$$

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			50

$$\frac{50}{3} = 16.6\%$$

2. **Protein supplements**

Ground nut. Seed cake	30%	2	60
Cotton seed cake	38%	1	38
TOTAL		3	98

$$\frac{98}{3} = 32.6\%$$

$$\text{Basal feeds needed} = \frac{14.6}{16} \times 500 \text{ kg} = 456.25\text{kgs}$$

$$\text{Protein supplement} = \frac{1.4}{16} \times 500 \text{ kg} = 43.75\text{kgs}$$

Amount of maize bran needed
 $\frac{2}{3} \times 456.25 = 304.2 \text{ Kg}$

Amount of rice bran needed
 $456.25 - 304.2 = 152.05$
 Amount of G.nut cake needed
 $\frac{2}{3} \times 43.75 = 29.2 \text{ Kg}$

Amount of Cotton seed cake needed
 $43.75 - 29.2 = 14.55 \text{ Kg}$

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

$$100 - 2 = 98$$

$$\text{Therefore} \quad \frac{16}{98} \times 100 = 16.3\% \text{ c.p of the final ration}$$

Basal feeds

Maize bran	15% c.p	1	15	<u>39</u>	
Elephant grass 12% c.p	<u>2</u>	<u>24</u>	3	=	13%
		3	39		

Protein Supplement

Soya bean meal	38% c.p	2	76		
Fish meal	40% c.p	<u>1</u>	<u>40</u>		
		3	116		
			<u>116</u>	=	38.6%
			3		

$$\text{Basal feeds needed} = \frac{22.3}{25.6} \times 98 = \text{Total} = 25.6 \quad \mathbf{85.40\%}$$

$$\text{Protein supplement} = \frac{3.3}{25.6} \times 98 = \mathbf{12.6\%}$$

$$\text{Minerals} \quad \mathbf{02\%}$$

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

$$100 - 3 = 97$$

$$\frac{18}{97} \times 100 = \mathbf{18.5\%}$$

Basal feeds

Wheat bran 22%

Protein supplement

Cotton seed cake	35%	1	35
Soya meal	38%	2	76
Fish meal	40%	<u>3</u>	<u>120</u>
		6	231
		<u>231</u>	= 38.5%
		6	

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:-

Roughages and dry forage e.g. hay.

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Pastures – These include range plants, grasses or legumes fed green.

Silage – This is fermented fresh grass.

Basal feeds or energy feeds – maize bran, rice bran, maize grains etc.

Protein supplement e.g. fish meal, blood meal, cotton seed cake, groundnut cake, sunflower, Soya bean meal etc.

Minerals – These are a good source of minerals like calcium, phosphorous, cobalt, magnesium, zinc, etc copper etc.

Vitamins e.g. A, B, C and B-complex

Additives: These are added to feeds to meet various requirements e.g. **hormones** that stimulate growth, antibodies to control disease, **drugs** to control disease, **antibiotics** to kill pathogens, heat **synchronizing hormones**, **anti-oxidants** to control oxidation of oils in feeds and **flavorings** to improve feed flavour.

1. MINERALS

Importance of minerals in Animal production

- They are responsible for tissue irritability e.g. calcium and magnesium.
- Some are important for the physical and chemical reactions in the body e.g. magnesium that activates enzymes.
- They are important in the clotting of blood e.g. calcium.
- They play a structural role more especially in the skeleton e.g. calcium and phosphorous.
- They maintain the osmotic pressure of blood and lymph fluid at the cell membrane e.g. potassium.
- Some are important in the reproductive system e.g. Manganese which increases sex libido.
- 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)

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 calcium, phosphorus and vitamin D.

Calcium

Phosphorus

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.

❖ 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 is a good source.

❖ 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 **depigmentation** of hair.

❖ Iodine

This is a constituent of thyroxine 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 thyroxine.

❖ 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)

❖ 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

❖ Phosphorous

- Strengthens bones
- Improves growth
- Improves fertility

Deficiency

- Poor growth
- Reduced appetite
- Poor milk yields
- Low fertility

❖ Potassium

Maintains concentration of body fluids

Helps in nerve transmission

Deficiency

- Slow growth
- General weakness
- Nervous disorders

❖ Salt (Sodium chloride) Na^+ and Cl^-

Used in nerve transmission

Deficiency

- Reduced appetite
- Loss of weight
- Reduced milk yield
- Death after prolonged deficiency

2. 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

- **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.
- **Water quality;** animals will take more of fresh water as compared to salty stinking water
- **Availability of water;** animals drink more water once readily available at all times
- **Increased environmental temperature;** this increases water intake as animals lose more water by evaporation
- **Animal health;** sick animals may take less water than expected
- **Level of animal production;** high milk yielders take a lot of water to compensate for that lost through milk secretion
- **Type of animals;** cattle will take more water than goats due to their size
- **Age of animals;** young animals will take less water as compared to mature animals
- **Water temperatures;** animals will take less of cold water as compared with warm water

DIGESTION IN RUMINANTS

1. Mouth

Food is gathered here with the help of tongue and teeth, a process referred to as prehension.

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.

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 39⁰c 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.

4. Reticulum

It's known to have a honey comb structure surface. Regulates passage of food from the rumen to the Omasum and from the rumen to Oesophagus

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. Abomasums (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.

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, foetal 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

Carbohydrate digestion in ruminants

- ❖ Ruminants do not have salivary amylase therefore the first enzymes to act on carbohydrates are in the rumen
- ❖ Enzymes in the rumen for carbohydrates are produced by the microbes
- ❖ Microbial amylase and cellulase breaks down starch and cellulose respectively
- ❖ 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.
- ❖ 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.
- ❖ VFAs are absorbed and utilized for energy production rather than glucose used in non ruminants
- ❖ Acetic acid is the main source of energy in ruminants.

Nitrogen conservation mechanism in ruminants

- ❖ Digestion of coarse fodder in ruminants depends on the activity of micro organisms in the rumen.
- ❖ The micro organisms require supply of energy and nitrogen for their growth and multiplication. In return micro organisms brake down cellulose
- ❖ 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;
- ✓ Ammonia absorbed from the rumen plus that arising from tissue metabolism is converted to urea.
- ✓ 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.
- ✓ The recycled urea is utilized by the rumen microbes to build up proteins for the host animal.
- ✓ The proportion of urea to nitrogen recycled depends on the quantity of nitrogen in the diet
- ✓ Low dietary nitrogen causes more nitrogen from the liver being returned to the rumen to build protein
- ✓ The cycle ensures continuous source of nitrogen for rumen digestion.

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.

❖ Grass Tetany

This is also called grass staggers/ hypomagnesaemia. It affects cattle and sheep mainly and it's caused by magnesium deficiency.

Symptoms:

- Animal becomes nervous
- There is twitching of the muscles more especially those around the head and the neck.
- The head of the animal is lifted high
- There is accelerated respiration
- There is increase in body temperature and gashing of the teeth.
- Abundant salivation which is followed by death
- It occurs during the 1st week of the pasture season.

Control

- Animals should be given mineral lick which contains magnesium sulphates, calcium and phosphorous.

❖ 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:

- Feeding of animals on young succulent grass with high protein content.
- Rumen microbes interfering with normal release of gases
- Some animals are more susceptible to bloat than others naturally.
- Some plants contain compounds which tend to form lather (foam) once eaten by animals.
- Feeding animals on feeds that are known to cause bloat.

Symptoms:

- Extension of the rumen
- Difficulty in breathing
- Loss of appetite / animal stops to eat
- Death of the animal
- Animal lies down and sticks its legs out.

Treatment:

- Affected animal should be treated using a trocar and cannula which is used in piercing the rumen to release the gases.
- The animal should be given mineral oil orally to open up the system so as to allow gases out.
- Use of the broom sticks 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

❖ **Ketosis** (acetonemia / pregnancy toxaemia)

A disorder of animals caused by high production exceeding feeding capacity of the animal
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. 38.6⁰ in cattle, 39.1⁰C 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

Infectious disease

This is a disease caused by living organisms like bacteria, protozoa, fungi and virus.

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.

Contagious disease

This is a disease transmitted by contact between infected animals and healthy ones e.g brucellosis.

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.

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.

HOW DISEASES CAN BE SPREAD ON THE FARM

- Introduction of sick animals to the farm, which can transmit disease to the healthy ones by contact.
- Introduction of healthy animals that are carriers of certain diseases.
- Diseases can also spread through contaminated water and feeds.
- Vectors like tsetse flies and ticks can also transmit disease.
- Wild birds and rodents may carry disease to the domestic animals through contaminating feeds and water.
- Contaminated equipment like vaccination equipment, drenching guns, insemination syringe may spread disease.
- Shoes and clothing of any one who moves from flock to flock or in animal quarters can spread disease.
- Airborne organisms like bacteria spores may be spread through air and cause disease.
- Soil can harbour resting stages for anthrax spores which can survive for up to 40 years.
- Diseases can also be spread through infected animal products like eggs in birds can spread new castle to chicks
- Improper disposal of dead animals that have died due to a certain disease
- Dung or excreta incase of cows and other young stock can also spread disease.

General Control of diseases on the farm

- Farmers should make sure animal quarters are clean to keep off pathogens.
- There should be adequate ventilation in the houses to control respiratory infections like pneumonia.
- Ensure adequate spaces for each animal hence discourage over crowding.
- Animals to be bought should be selected from reliable source with less risk of disease.
- Institute quarantine measures incase of a disease outbreak in an area.
- Practicing rotation grazing in cattle in order to control vectors like ticks.
- The farmer should follow vaccination programmes for livestock in order to control disease.
- Visitors to the farm should be restricted and those allowed in should be disinfected.
- Sick animals should be isolated from the general herd or flock to reduce disease spread.
- Dead animals should be properly disposed by either burning the carcass completely or burying it 3m deep in the soil.
- Animals with highly infectious disease should be culled by slaughtering and burning the carcasses completely.

- Newly bought in animals should be isolated from the general herd for At least 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 rot
- 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

Obligate parasites

These live their entire life as parasites and cannot survive without a host e.g. the tape worms.

Facultative parasite

These can live freely in the absence of a host and as a parasite in presence of the host i.e. fleas.

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.

Ecto parasites / External

These live on the outer surface of the host and derive their nourishment from there e.g. ticks pig lice, mites.

Ecto-endo parasites

These live in the outer skin surface of the host e.g. jiggers and mange 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

TICKS.

Classification of ticks

Kingdom

Phylum :

Class

2.

Order

Super family

Sub families 1:

Sub families 2:

Animalia

Arthropoda (jointed appendages)

Arachnida (4 pairs of legs) the body is divided into

Acarina

Oxodoidae

Oxodidae (hard ticks)

Argasidae (soft ticks) mainly in chicken

Hard ticks.

These include the following;

- | | |
|--------------------|--|
| a. Bont tick – | (<u><i>Amblyomma variegatum</i></u>) |
| b. Blue tick – | (<u><i>Boophilus decoloratus</i></u>) |
| c. Brown ear tick | (<u><i>Rhipicephalus appendiculatus</i></u>) |
| d. Red legged tick | (<u><i>Rhipicephalus evertsi</i></u>) |

GENERAL LIFE CYCLE OF TICKS

- ❖ After matting, the female sucks blood to full engorgement.
- ❖ It later detaches off from the host and finds a suitable protected environment on the ground where it lays the eggs.
- ❖ Depending on temperature and humidity, the eggs would hatch into larvae at least after two weeks.
- ❖ The larva climbs on top of grass to try and find a host.
- ❖ After finding a host, the larva feeds for 3-4 weeks then moults into a nymph.
- ❖ 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.

One host tick (blue 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)**.

Two Host tick (red legged)

- 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)**.

Three 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	✓ <i>Theileria parva</i>	✓ East coast fever (E.C.F) ✓ (Theileriosis)
		✓ <i>Anaplasma marginale</i>	✓ Anaplasmosis.
2	Blue tick	✓ <i>Anaplasma marginale</i>	✓ Anaplasmosis

3	Bont tick	✓ <i>Rickettsia ruminantium</i>	✓ Heart water
		✓ <i>Theileria mutans</i>	✓ East coast fever
4	Red legged tick	✓ . <i>Babesia bigemina</i>	✓ Red water

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 a hermaphrodite though cross fertilization has also been observed.

The life cycle of a liver fluke

- ✓ Eggs are laid in the liver and carried to the alimentary canal
- ✓ Eggs come out with the faeces and are deposited in water
- ✓ The eggs develop into larva called miracidium.

- ✓ The miracidium swims in water to find the intermediate host which is the water snail (*Liminaea trancatula*)
- ✓ While in the water snail, it moults into a sporocyst.
- ✓ The sporocyst ruptures to release a new type of larva called redia while in the snail.
- ✓ The redia migrates into digestive gland of the snail where it grows and produces the cercaria.
- ✓ The cercaria leaves the snail and enters water where it can swim until it's taken by the animal while drinking water.
- ✓ The cercaria while in the body of the animal can develop into adult flukes and the cycle continues.

Damages 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 jaw
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 faeces / 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 flukes

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 discourage 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 rear 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 faeces.
8. Coughing by the animal which can be occasional.

Adaptations of gut worms to their mode of life

- ❖ Degeneration or loss of unwanted organs and structures like eyes, legs and ears.
- ❖ They have penetrative devices for gaining entrance into the host and attaching themselves in the gut walls so that they cannot be dislodged
- ❖ Presence of sucking devices like in the tape worm which helps in sucking nutrients.
- ❖ Possession of hard cuticle which can resist the host's digestive enzymes.
- ❖ Production of large quantities of mucus against the host's digestive enzymes.
- ❖ They have more than one host which increases their chance of survival.
- ❖ Production of a large number of eggs to increase their survival chances.
- ❖ Possession of muscular pharynx in round worms for sucking nutrients from the host.
- ❖ Most gut parasites are able to tolerate low levels of oxygen common in their environment.
- ❖ Some are hermaphrodites like the tape worm which increases the chance of survival by ensuring fertilization and reproduction.
- ❖ A large surface area has been observed in the tape worm and liver flukes which increases diffusion of oxygen and nutrients.
- ❖ 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

- ✓ Adult tape worm in the intestines of man lays fertilized eggs
- ✓ Eggs are passed out with feaces
- ✓ Eggs develop into oncosphere which are eaten by grazing pigs or cattle
- ✓ Each oncosphere contains six hooked embryo called hexacanth
- ✓ The wall surrounding the hexacanth is digested in the duodenum to release bladder worms
- ✓ The bladder worms bore through the walls of the intestines and enter blood or lymphatic system
- ✓ They are taken to the voluntary muscles of the tongue and limbs
- ✓ Badly cooked meat eaten by man the bladder worm is eaten
- ✓ The bladder worm attaches it self on the walls of the intestines and develops into a tape worm