

LIVESTOCK PRODUCTION

It deals with management and production of livestock and livestock products.

Groups of livestock

These include cattle, sheep, poultry, rabbits, pigs, goats and bees. The commonest of these are cattle, goats, poultry and pigs.

Importance of livestock to man

- (i) Provides animal protein such as beef, eggs, milk etc.
- (ii) it is a treasure of wealthy
- (iii) It provides materials like hides and skins.
- (iv) Provides drug for construction, fuel and manure.
- (v) Used in accomplishment of traditional issues such as dowry and other cultural functions.
- (vi) Livestock keeping plays a key role in agricultural diversification.
- (vii) Animals provide power on the farm for cultivation and transportation.
- (viii) Livestock provides employment opportunities to farmers, vet. Doctors, Agriculturalists and other stake holders.
- (ix) Sheep provide wool for the textile industry.
- (x) Bull fights and horse races are used for amusement and entertainment.

Factors that affect distribution and production of livestock in E. Africa.

1. **Climate:-** Regions with a favorable climate in terms of rainfall and temperature can support pasture for grazing and also provide a good environment for livestock production.
2. **Parasites, diseases and vectors:-** These greatly affect and lower the production of livestock. That is why in places like the tsetse infested miombo woodlands cannot support livestock production.
3. **Altitude:-** Some animals cannot live at high altitude like mountains and highlands.
4. **Population density:-** Places with low population density tend to have plenty of grazing land for raising livestock.
5. **Vegetation cover:-** Gazated areas for forestry do not support domestic animals. Examples include Mabira, Budongo and Bwindi impenetrable.
6. **Economic factors:-** These include capital, transport, market and communication. Livestock production can always be successful in areas endowed with these facilities.
7. **Social and cultural factors:-** Some cultural groups like Turkana, Kijong, Masai and Banyankole are traditional cattle keepers and have got more animals compared to other tribes.
8. **Religious factors:-** All types of livestock are allowed in Christian communities while pigs are not allowed in Islamic communities.

- 9. Government policy:** - In some countries, livestock keeping is done only on ranches and this is where production features most.
- 10. Security and political instability:** - Livestock keeping is greatly affected in areas ravaged by civil wars and other activities like raids and rustling.

Strategies for improvement of livestock production

- (i) Adequate provision of vet services and drugs for the control of livestock parasites and diseases.
- (ii) Credit facilitation to farmers by agencies like banks and co-operative societies for capital to effect improvement of the farming practice.
- (iii) Improvement of transport facilities by tarmacking feeder roads for easy access to market and better services.
- (iv) Pastures should be improved through irrigation, control grazing and introduction of better plant species.
- (v) Provision of sufficient water through dam construction and weir improvement.
- (vi) Improvement of herds through cross-breeding and A.I.
- (vii) Extensive education of farmers through extension services and refresher courses.
- (viii) Proper organization of marketing livestock products through co-operative societies and marketing boards.
- (ix) Security should be improved by disarming cattle raiders and finding a lasting solution to civil wars.
- (x) There should be adequate research in connection with coupled development of suitable stock.

Activity one.

With the teacher's help, arrange to visit the various livestock farmers near your school.

- Which types of livestock exist in the area?
 - What are the advantages of rearing each type of animals?
 - What problems do livestock farmers face in this area and what are the possible solutions?
 - What feeds does each of these animals take?
- Prepare a report from your findings.

Stockman ship

This is the practice of caring for livestock.

An individual who takes care of livestock is called a **stock man**.

Qualities of a good stockman

1. He should be kind to his animals i.e., shouldn't pull ears, twist tails or beat up animals.

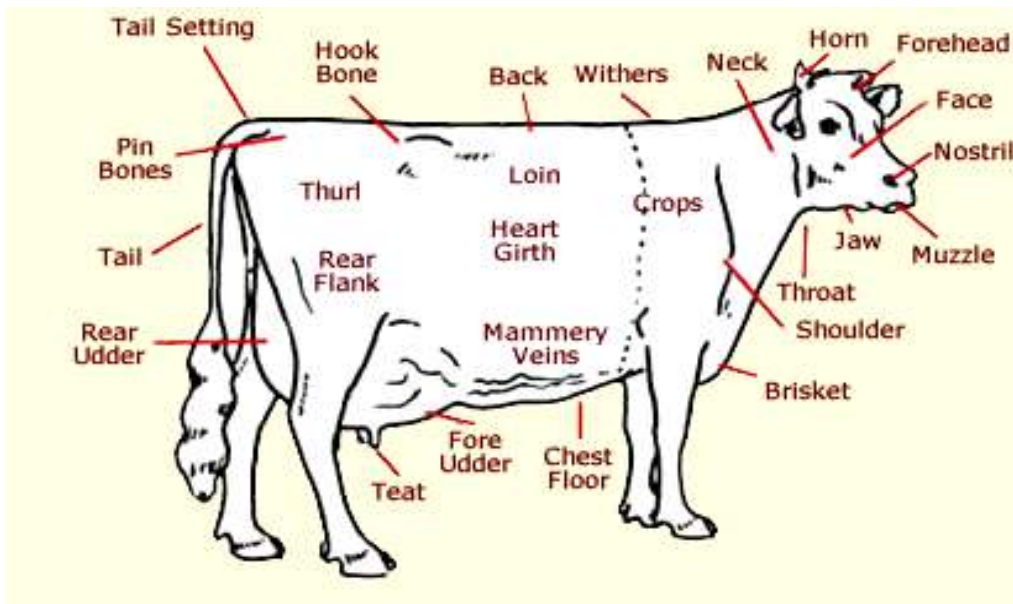
2. He should carry out daily and monthly routine operation such as drenching, spraying and dipping.
3. He should maintain hygiene in the grazing paddocks and in the general farm environment.
4. He should be able to keep records of production, feeding, health and breeding of animals.
5. He should be able to tell the physiological needs of animals such as signs of heat, hunger, thirsty and pain.
6. He should be able to identify symptoms of sick animals and get them treated.
7. He should be in position to control animal parasites such as worms, ticks and flukes in his grazing area.
8. He should be personally healthy and clean.
9. He should be honest and able to work with minimum supervision.
10. He should be able to take quick decision and action whenever necessary.

CATTLE PRODUCTION

Some common terms used in cattle production

1. **Bull:** - An adult uncastrated male ox.
2. **Steer:** - A castrated male ox-over 2yrs of age.
3. **Cow:** - A female ox after her first calf.
4. **Heifer:** - A female ox over 1yr but before her first calf.
5. **Calf:** - A young ox below one yr. males and females are called bull calf and heifer calf respectively.
6. **Kraal:** - An open enclosure where animals are kept especially at night.
7. **Herd:** - A group of cattle.
8. **Calf pen or barn:** - An enclosed shelter for keeping calves.
9. **Buller or Nymphomaniac:** - A cow that always appear to be on heat.
10. **Open animal:** - A female animals that has not been bred.
11. **In-calf heifer** - A pregnant heifer.
12. **In-calf cow**- A pregnant cow.
- 13 **oxen** - castrated male cattle that has been trained to provide labour on the farm

THE PARTS OF A COW



Breeds of cattle

1. Local (indigenous) breeds [Bos indicus /.

Characteristics of local cattle.

Majority of local cattle are humped and other characteristics include the following.

- Generally small and body weight is less than 400kg.
- They take long to mature.
- They are tolerant to heat [15`c-30`c].
- produce milk with high butter fat content than exotics.
- Generally tolerant to tick born diseases.
- They have more sweat glands than exotic cattle.
- They have long legs for fast movement.
- They produce less milk compared to the exotic breeds.
- Have a well- developed dewlap , navel flap and hump to increase the surface area for cooling.
- They have long and narrow heads that have large horns.
- They have long ears and long faces.

The local breeds include;

(a)**The small E. African Zebu:** - These are small animals widely distributed in E. Africa. They good herbage-milk converters. They are also tolerant to tick borne diseases and T.B. examples are Nandi cattle in Kenya and Teso cattle in Uganda.

(b)Long horned (Sanga) cattle: - These are common in south western Uganda and northern TZ. They have long horns and are better milkers but poor beef producers. They are susceptible to T.B.

(c)Intermediate breed: - These are a cross between Ankole and Zebu. They are common in Buganda, Busoga and Masai in Kenya. In Buganda they are called Nganda, Basoga Nsoga etc. they are better milkers and less susceptible to T.B. than Nsanga.

(d)Boran cattle: - It is another type of short-horned Zebu, belonging to the Borana people of Kenya. They are also found in Somalia, Ethiopia, Kenya and other parts of E. Africa. They grow very fast and are very good milk and beef producers. They have an exotic conformation.

Advantages of bos indicus,

- Can tolerate strong heat.
- Able to walk long distances in search of water and pastures.
- Are relatively tolerant to tick born diseases.-
- Have tough muscles and are good for ploughing.
- Produce milk with a high butter fat content.
- Have fewer reproductive problems and can breed for a long time.
- Cheaper to buy and maintain.

Disadvantages of bos indicus.

- Produce fewer carcasses [low live weight]
- Take long to grow hence reach puberty late.
- Have a poor temperament.
- Production is low in terms of milk and meat.

2. Exotic breeds

The bos Taurus species are hump less cattle .they originate from temperate countries like Germany ,Denmark and England .they are imported into the country for milk and beef production .

many farmers have used them to improve local breeds .some of the breeds in this species are Friesian, charolais,herrford, Galloway, redpoll ayrshire and Aberdeen angus.

Characteristics of bos Taurus

- they are hump less.
- some have short horns or are polled. [Hornless].
- dewlap and navel flap lacking.
- have short legs.
- Not tolerant to tick borne diseases.
- They have short faces and short ears

(i) Dairy breeds: - These are animals kept for milk production. They include;

(a) Hotstein Friesian: - It originated in Holland. It is the best milker.

- (b) **Guernsey:** - Originated in the isle of Guernsey in the English Channel. It is a good milker but known for its exceptionally good temperament.
- (c) **Jersey:** - It is a small animal from the Jersey Island in the English Channel. They are quite easy to keep because they consume less.
- Other exotic dairy breeds include the Jamaican hope, Brown Swiss and Sahiwal.

Characteristics of a good dairy animal

- (i) It has a good temperament and easy to handle.
- (ii) It has high herbage milk conversion capacity.
- (iii) It calves easily and has a few rep-problems.
- (iv) It has a triangular or wedge-shaped body.
- (v) It has well pronounced and developed milk veins.
- (vi) It has a fairly light weight in comparison to beef animals.
- (vii) Its lactation production is fairly long (about 300days) after calving.
- (viii) It has fairly wide and well set hind legs to accommodate the large udder.
- (ix) It has good resistance to diseases.

(ii) **Beef breeds:** - These are animals kept for beef production.
They include:-

- (a) **Aberdeen Angus:** - Originated in North-East Scotland. It is a small polled early maturing animal with the best beef quality whose fat is well distributed through the muscles.
- (b) **Hereford:** - It originated in the Hereford shire in England. It produces bigger carcass but of lower quality than the Aberdeen Angus.
- (c) **Galloway:** - It originated in Scotland. It is a black animal, smaller than the Angus and quite adapted to the tropical climate.

Other beef breeds include Short horns, American Brahman and Santa Gertrudes.

Characteristics of good beef breeds

- (i) They are thick well built muscles.
- (ii) They mature early and reach slaughter age quickly.
- (iii) They have short, well set legs to support the weight.
- (iv) They have a blocky or square body conformation.
- (v) They have good herbage beef conversion capacity.
- (vi) They are high fertility and calving rate.
- (vii) They shouldn't have inheritance abnormalities.
- (viii) They should be well adapted to the prevailing climatic conditions.
- (ix) They should be resistant to parasites and vectors.

(x) They should also be disease resistant.

(iii) Dual purpose breeds: - These are kept for both milk and beef production. Examples include the milking short horn and the red poll.

Differences between local and exotic breeds of cattle

Local breeds (<i>Bos indicus</i>)	Exotic breeds (<i>Bos Taurus</i>)
- Well adapted to tropical climate	- Adapted to temperate climate.
- Tolerant and resistant to tick borne diseases.	- Greatly affected by tick borne diseases.
- They are hardy and can walk long distances in search of pasture and water.	- Not hardy and can even breakdown in such circumstances.
- Small in size and slow at maturing.	- Bigger in size and fast maturing.
- Normally produce less milk and beef.	- Produce much more milk and beef.
- Have a few reproductive problems.	- Have many reproductive problems.
- Can feed well on roughage and unbalanced feeds without effects	- Greatly affected by poor feeding.
- Quite cheap to raise and maintain.	Very expensive to look after.

Preparation of the farm before introduction of exotic breeds

- (i) Improve the pasture land by planting more potatoes pasture specie to provide adequate herbage.
- (ii) Make the farm tick free by spraying with acaricides
- (iii) Provide drugs and basic vet equipment on the farm.
- (iv) Facilities such as crushes and dips should be established on the farm.
- (v) Drain the farmland to control flukes.
- (vi) Drench all indigenous animals on the farm to get rid of round worms and other internal parasites.
- (vii) Ensure that there s enough shade and shelter for animals on the farm.
- (viii) Provide adequate water supply on the farm.
- (ix) Seek advice from vet officers and experienced farmers.

Activity two

Visit a farm with both local and exotic cattle. Request the stocks man to guide you in the following areas.

- Points of a cow.
- characteristics of local and exotic cattle.
- problems associated with exotic cattle.
- Share your answers with the class.

Activity three.

Diagnostic questions.

1. Give reasons to support the role of livestock in an agricultural sector.
2. Mention any four breeds of exotic dairy cattle.
3. What problems are faced by livestock farmers.
4. Suggest possible remedies to these problems.
5. Give the reasons why exotic cattle are better than local cattle.

CATTLE BREEDING

Breeding is the process through which animals which are mature give rise to offspring through mating. It involves mating of animals that have been selected in a planned manner.

Reasons (Aims) for breeding farm animals.

- (i) To improve on quality and quantity of products like meat, milk and wool.
- (ii) To improve on animal resistance to diseases.
- (iii) To give rise to animals that are adapted to local climate. I.e. to produce animals that are resistant to adverse environmental conditions.
- (iii) To improve on the growth rate of animals.
- (iv) To improve on the fertility rate of animals.
- (v) To improve on physical characteristics of cattle e.g. body conformation.
- (vi) To produce animals that are economic and cost effective to maintain.
- (vii) To produce better yielding animals.
- (viii) To produce animals with good temperament for easy handling during.
- (ix) To get animals that are prolific.
- (x) To improve conformation of the animal.
- (xi) To get animals with good quality products such as BFC, wool, marbling, etc

Terms used in Breeding.

• **Inheritance**

It is the ability of animals to pass on their characteristics to their offsprings. Male and female gametes contain small units called genes. Genes are found in the chromosomes and are responsible for carrying characteristics of an individual animals. Animals therefore pass on their characteristics to their off springs through genes.

Genes contain a pair of alleles. Alleles are actual carriers of characters, for example, colour like white, black or brown. These alleles [genes] are carried in the sperm's nucleus and the nucleus of female eggs. They are singly placed in the nucleus in the process of meiosis. Each gamete has a single allele representing a character. For instance, a male gamete has B representing brown colour and a female gamete has W representing white colour.

In genetics, a capital letter is used to represent a dominant gene while a small letter represents a recessive gene. **A dominant gene** is the one whose character is expressed or seen in an individual. For instance, male gamete with B [brown dominant] combines with female gamete with W [white recessive] the offspring will be brown.

This type of offspring has underlying characteristic of whiteness but it is suppressed by brown, so we say, white is recessive. This could still be explained by the fact that in chromosomes, genes are sited at particular points called loci.

Genes at particular locus describe a given character. When genes interact, the presence of one gene suppresses the action of the other. This act is called **epistasis**. The gene that suppresses is called epistatic and the suppressed is called **hypostatic**

- **Heterosis (hybrid vigor):** This is extent to which an animal performs better than the parents. Such a situation is reached through cross breeding. The off springs produced will be able to perform more than double the average of the parents. This type of offspring is known as hybrid.

Selection of farm animals.

Different animals have different characteristics. It is important for a farmer to look for good characteristics when choosing animals to breed. This process where individuals with good characteristics [traits]. Are chosen to be parents of the future generation is known as selection.

Animals with good characteristics pass them on to their progeny [offspring]. This results in improvement of the herd. Animals with bad traits should be removed and sold or slaughtered. The process of removing unproductive animals from the farm is referred to as culling.

Methods of selection.

As stated earlier, selection is aimed at preserving the good traits in animal breeds and eliminating bad ones. This is accomplished by studying the production and reproduction records of the animals to be selected.

Before selection is carried out effectively, one should consider the effects of genes on inheritance and environmental influence on the characteristics of individual animals. This greatly determines the methods of selection to use. The various methods of selection are mass selection contemporary comparison, collateral relative progeny testing, and tandem selection and pedigree selection.

- **Mass selection:** selection based on gene influence, for example, skin colour, other than environmental, is carried out using mass selection method. Mass selection is the choosing of individuals purely on the basis of their appearance and allowing them to mate randomly. This is the most reliable and efficient method when considering inheritable characteristics. In dairy animals, characteristics include butterfat content, growth rate and mortality at birth. However milk yields weakly inherited so it can't be relied on when using mass selection.
- **Contemporary comparison:** selection based on the performance of individual bulls and heifers in the herd is regarded as contemporary comparison. the animals compared are of about the same age.
- **Collateral Relative selection:** This method is based on the performance of many animals that are closely related. It should be used for traits that are highly inherited and when there is limited interval between generations. It is more suited for poultry than cattle.
- **Progeny testing:** Animal is evaluated on the performance of its offspring after which it is selected or rejected. it invaluable when considering traits like milk which cannot be seen males
- **Tandem selection:** selection basing on one trait at a time until it is improved and then another selected. For example Beef fat content, then disease resistance, etc.
- **Pedigree selection:** This method is based on the performance of the parents (ancestors). This requires presence of well kept records.

Factors considered when selecting animals for breeding

1.Climatic adaptability:- Animals that a well adapted to local climate should be selected i.e. animals chosen should be able to adapt to environmental conditions without losing weight.

2. Disease resistance: - Priority should be given to animals that are resistant or tolerant to the common diseases. This enables them to survive in case there is an outbreak.

3. Reproductive qualities: - Animals with a few calving complications should be selected.

4. Feeding characteristics: - Heavy feeders are always less economic for commercial purposes.

5. Longevity: - Animals with longer lifespan are preferred.

6. Milk and beef production record: - Good producers of these products are given priority for the respective enterprises.

7.Body conformations:- ; animals chosen should conform to the characteristics of either beef, dairy, dual purpose, broilers or layers i.e. Dairy and beef breeds have got particular body shapes that depict quality.

8. Temperament: - In case of dairy breeds , choose those which have good temperament. This enables easy handling during milking and in case of steers [oxen] , handling during ploughing becomes easy.

9. Strength of the animals: - This is essential when selecting animals for farm work.

10. Lactation period: - Animals with a long lactation period are usually preferred.

11.Productivity of parents; select animals whose parents are good producers of meat , milk, wool or eggs and must be productive for along period of time...

12.Age; select animals which are still young but have attained sexual maturity. Avoid old animals as their productivity level decreases with increasing age, young animals can stay in production for along time

13.Feed conversion rate; chosen animals should have a high ability to change food eaten into useful products such as eggs, milk and meat.

14. Maturity period; select animals which have a high growth rate. This means that can reach the production or breeding stage quickly. This will contribute to an increase in the number of animals on the farm. Early maturing animals can be sold off early and the farmer will be able to realize profits in a short time

The table below shows some of the factors to consider when selecting a breeding stock

Table one; selecting breeding stock.

Animals	Factors considered.
---------	---------------------

Cattle	-Conformity of the breed, for example, beef, dairy or dual purpose. -Fecundity [ability to calve down regularly]. -longevity [ability to stay in production for along time]. - -Temperament. [Easy to handle]. - -High growth rate. - -Well developed udder well spaced teats. - -Healthy and without inheritable diseases. - -Quick adaptation to environmental conditions - -Resistance to common parasites and diseases. - -Age [choose animals which are still young]. - -As for the above but the ram should have the ability to take service. - -Should be able to produce high quality products.
Pigs	-Number of teats should be about 12 or more. -Should have a long body. -Should have a high feed conversion ratio [weight gain]. -Should have a high growth rate. -Should be easy to handle i.e with a good temperament. -Should be chosen from healthy parents. -Should be able to conform to the breed characteristics.
Goats	-Conformity to breed type [either beef or dairy]. -Developed udder with two well spaced teats. -Fast growth rate. -High fecundity [regular kidding rate]. -Free from inheritable diseases -Normal physical appearance [not deformed]. -Should still be young enough

Camels

- Resistant to common parasites and diseases.
- Adapt ional to environmental conditions should be good.
- Adoption to surroundings.
- Ability to produce good meat.
- Able to withstand heat stress.
- Having a high calving percentage.

Breeding systems

These are:-

1. In breeding
2. Out breeding

1. **In breeding:** - In breeding involves the mating of related animals. In such a case, a parent is allowed to mate with its off springs or close relatives.

Advantages of in breeding

- Improves on uniformity of animals in the herd.
- Bad traits can be easily identified and prevented.
- It leads to concentration of good traits if present.

Disadvantages

- Can lead to an increase in mortality rate in the herd.
- It encourages hereditary diseases.
- It may lead to loss of hybrid vigor.

Categories of in breeding

- (a) **Line breeding:** - It is the mating of distantly related animals. It aims at keeping some desirable characteristics of some ancestors and avoiding undesirable ones at the same time e.g.

- Bull X grand daughter
- Half brother X Half sister
- Grandson X female

- (b) **Close breeding:-** It is the mating of very close related animals e.g.

- Bull X daughter
- Cow X son
- Brother X sister.

2. **Out breeding**: - Out breeding involves mating animals that are completely unrelated. The animals should be of pure breeds.

Advantages of out breeding

- It improves on the hybrid vigor in terms of growth rate, fertility, and milk and beef production.
- It improves on disease resistance among animals.
- A variety of good traits are developed.

Disadvantages of out breeding

- Its success necessitates strict record keeping of animals' ancestors.
- Restriction of mating to unrelated animals can be difficult.
- Good traits can be lost during the crossing.

Categories of out breeding

- (a) **Cross breeding**: - It is the mating of 2 different pure breeds of animals e.g.

- Friesian X Jersey
- Zebu X Guernsey
- Galloway X Ankole
- Angus X Sahiwal

- (b) **Line crossing**:- It is the mating of 2 animals that have been developed from 2 different lines of ancestors. These should be of same or different breeds.

- (c) **Up grading**:- This is the recurrent or continuous back crossing of a local (less productive) and exotic (superior) breed to develop better herd e.g.

The F1 has 50% of the genes of improved sire. The F2 female offspring has 75% of the genes of the improved male. The F3 female offspring has 87.5% of the improved sires.

100% Zebu 100% Jersey bull.

F1- 50% x 100% Jersey bull

F2- 75% x 100% Jersey bull

F3- 87.5% x 100% Jersey bull

F4- 93.7% x 100% Jersey bull

F5- 96.8 x 100% Jersey bull

Breeding efficiency

Farmers carry out livestock improvement to ensure that there is continuous productivity from animals. This is achieved through maintaining a high breeding efficiency.

Breeding efficiency is the power of the animal to reproduce and multiply overtime. In other words, it is the fertility of the animals in the herd, i.e. it starts from conception through gestation up to calving.

Breeding efficiency is measured basing on the following:

- Number of progeny produced by the animal in its productive time.
- Number of service carried out for the animal to conceive.
- How long it takes to conceive after calving.(calving interval)
- Percentage of animals that have not gone on heat after service.

To improve breeding efficiency, farmers have to carryout the following management practices:

- Cows should be given a rest period of 2-3months before they are served after calving.
- Carry out pregnancy diagnosis 2months after services that the animal is served again if it did not conceive.
- Detect heat signs early enough to ensure service on time.
- Breeding records should be kept to determine whether the service was successful or not.
- Control reproductive diseases as they are responsible for the failure to conceive.
- Proper feeding of the animal to ensure good health.
- Personnel carrying out AI should be skilled.

Factors that can lower breeding efficiency in cattle

1. **Inheritance factors:-** These are conditions inherited
2. **Infectious diseases:-** These cause infertility in animals. They include Brucellosis, Vibrio foetus etc.
3. **Physiological defects:-** These can be physical complications with the reproductive system which prevent conception.
4. **Feeding:-** Poor unbalanced feeding especially lack of vitamins A and D can lead to infertility.
5. **Management factors:-** e.g. failure to recognize heat in animals by the farmer.

SYSTEMS OF MATING

These include;

- (a) Natural mating
- (b) Artificial insemination

(a) Natural mating; is when bulls are allowed to mount the cow on heat.

Here, male animals have natural ability to detect female animals on heat. Once detected, the animal mounts the female and deposits the sperms into the vagina.

Advantages of natural mating

- (i) It is quite cheap and affordable to most of the farmers.
- (ii) No timing and planning of breeding program is involved.
- (iii) Cows with silent heat can naturally be served.

Disadvantages of natural mating

- (i) Cost of maintaining the bull on the farm is very high.
- (ii) It encourages inbreeding on the farm.
- (iii) Big heavy bulls can break small cows/ heifers.
- (iv) Breeding diseases can be easily transmitted on the farm.

(b) Artificial insemination; is when semen is obtained from a bull and served to a cow on heat by an inseminator.

Collection of semen from the bull

Equipment used includes;

- An artificial vagina (AV)
- A teaser animal (female)
- The bull

Structure of the AV

Procedure

The teaser animal is brought close to the bull.

The bull gets stimulated and as it attempts to mount the animal, the operator swiftly gets the protruding penis and diverts it into the AV where the bull ejaculates.

N.B:-

1. A natural environment of temp, pressure and pulsation is created in the AV by warm water and a vacuum pulsator.
2. The inside of the AV is well lubricated to prevent friction that would cause injury to the penis.

After collection, the semen is well examined for fertility and STDs, then diluted before its stored for future use.

Introduction of semen into the cow

- The cow on heat is restrained, either in a crush or with a halter.
- Semen is withdrawn from the storage containers, using a pipette and carefully pushed the vagina to the cervix of the uterus. The animal will become pregnant if it is fertile.

Advantages of A.I

1. It controls in breeding in the herd.
2. Many STDs are controlled on the farm.
3. Semen from a variety of bulls can be used, giving the farmer a chance of improving on his herd.
4. It reduces the risk of heavy bulls injuring small cows.
5. Semen from old bulls, have bulls and those that died a long time ago can be used.
6. It eliminates the cost of keeping and maintaining the bull.
7. Many animals can be served from a single ejaculation thus avoiding wastage.
8. It facilitates easy programming and control of breeding on the farm.
9. It is easier to keep records when A.I is used than for natural mating.
10. It facilitates easy detection of infertility and sterility among animals.
11. Chances of fertilization are increased since semen is deposited at an appropriate place in the rep. tract.
12. It leads to introduction of new breeds in the herd.

Disadvantages of AI

1. It is difficult to detect heat period especially in animals that have silent heat.
2. It requires experienced inseminators to carry out the operation.

3. There is a risk of injury and wounding of the female animal in the process of insemination.
4. A lot of labour is involved in with drawing, testing and serving semen to the animal.
5. The process is expensive and may not be afforded by most of the farmers.
6. Sperms can die due to poor storage and transportation.
7. Insemination of a pregnant animal may lead to miscarriages.
8. If semen is not well examined, it can lead to a wide spread of diseases.

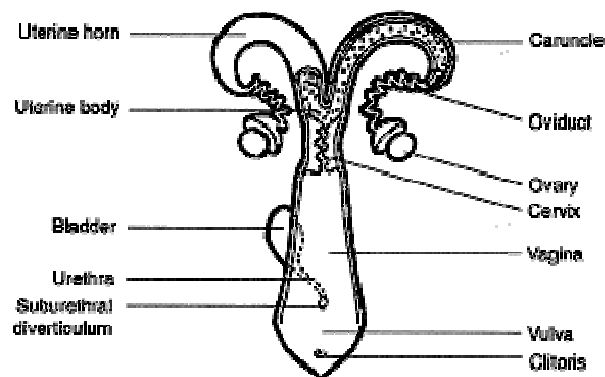
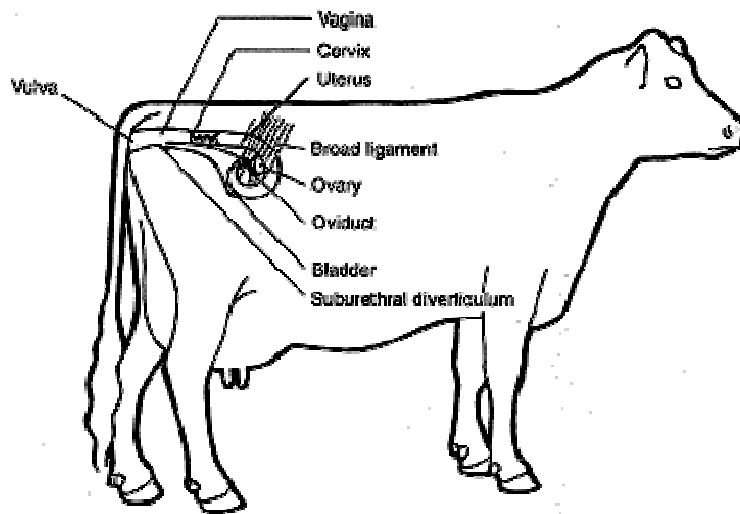
Exercise.

- (i) State the reasons for improving livestock.
- (ii) Explain factors to consider when selecting animals for breeding
- (iii) Why is natural mating preferred?
- (iv) Outline the steps to follow when carrying out rectal-vaginal method
- (v) What is artificial insemination?
- (vi) Why is artificial insemination gaining popularity among farmers
- (vii) Why is artificial insemination not widespread?
- (viii) How can breed efficiency be improved in a herd?

REPRODUCTION IN FARM ANIMALS

Reproduction is the biological process which involves fusion of the male and female reproductive cells to give rise to an offspring.

Parts of the female reproductive system of a cow

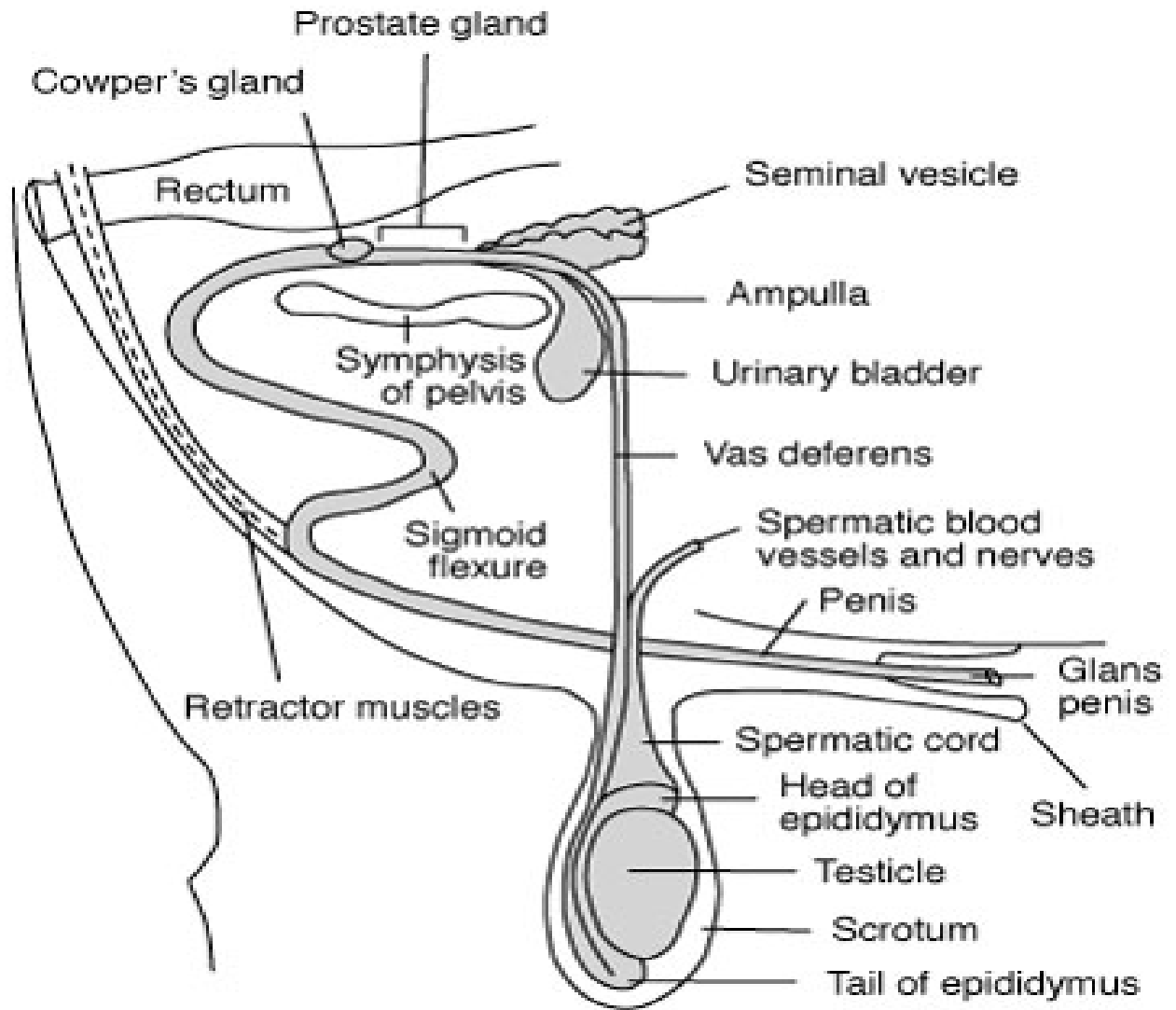


Functions of the parts

1. **Ovaries:-** These produce and release egg cells (ova)
2. **Funnels:-** They capture the egg as it leaves the ovary and deliver it to the oviduct.
3. **Oviduct (fallopian tube):-** It is where the egg is fertilized and delivered to the uterus.
4. **Uterus (womb):-** It has got muscular walls and it is where the fertilized egg is implanted and grows till time for calving.
5. **Cervix:-** It is a muscular ring, about 25mm in diameter. It closes and prevents entry of any other material into the uterus once the animal is pregnant.
6. **Vagina:-** It is a channel, with a corrugated lining designed to receive the penis of the bull during copulation.
7. **Hymen:-** It is a membrane that usually breaks the 1st time the penis of the bull enters. Failure of this hymen to break means the heifer will remain infertile (white heifer disease).

8. **Valva:** - It is the external opening of the vagina which aids expulsion of the calf at birth.

Parts of the male reproductive system.



Functions of the parts

1. **Testis:** - They are ovoid structures responsible for production of spermatozoa.
2. **Scrotal sac:** - It hangs below the body cavity and it is where the testis are contained.
3. **Sperm ducts (vasa deferens):**- These convey sperms from the testis to the urethra.
4. **Epididymis:** - It is a coiled tube where spermatozoa are stored after their production.
5. **Glands (Prostate, Cowper's and seminal vesicles):**- These produce fluids (semen) which contain nutrients and also act as a medium for mobility of sperms.
6. **Ampulla:** - It is a structure that aids in ejaculation of the sperms.
7. **Sheath:** - Protect the penis from pathogens and injury.
8. **Urethra:** - It delivers semen and urine out of the penis at the required time.

Hormonal control of the reproductive cycle in animals

When the ovum is mature in the ovary, the pituitary gland produces a hormone called follicle stimulating hormone (F.S.H) causes the graafian follicle in the ovary to secrete a hormone estrogen. The major function of oestrogen is to induce Oestrous (heat period):- the period when the animal is ready for mating.

During heat period, the pituitary gland produces another hormone, luternising hormone (L.H)

Functions of luteinising hormone are;

- To cause ovulation (movement of ovum from ovary to oviduct through funnel).
- To cause growth of corpus luteum in the ovary cavity left

After ovulation, the egg stays in the upper portion of the oviduct for some time, where it is met and fertilized by the sperm, before it descends to the uterus for implantation. Further development of the embryo (fertilized egg) occurs in the uterus till time for calving.

The period when the animal is pregnant is called Gestation period.

Table of gestation period

Animal	Number of days
Cow	270 / 280
Sow	115
Ewe	150
Rabbit	28 / 30

Activity four

- Pay a visit to nearby farm that has animals.
- Use the knowledge you have acquired in the text above to identify some parts of the reproductive systems of the male and female cattle or goats
- Write down the parts you were able to see in your notebook.

Other reproductive hormones include;

- (i) **Progesterone:-** Its secreted by corpus lateum

Functions are:-

- Inhibit the release of inteirusing hormone.
- Prepares uterine wall for implantation.
- Maintains pregnancy and causes uterine and mammary glands to grow.
- Facilitates secretion of uterine milk on which the calf feeds.

- (ii) **Testosterone:-** It s produced in the tests. It produces secondary sexual characteristics in males.

- (iii)**Protactin:-** Produced by the interior tube of pituitary gland. It s concerned with initiation and maintenance of milk production.

Oestrous (Heat period)

It is the period when the animal is ready to conceive upon mating.

Signs of heat in cattle

- (i) The valva becomes swollen and its colour turns reddish.
- (ii) There s mucus discharge from the valva.
- (iii) In lactating animals, there will be a drop in milk yield.
- (iv) The cow looses appetite for food and spends most of the time bellowing (mowing).
- (v) It urinates frequently.
- (vi) It tends to mount other animals and stands still to be mounted also.
- (vii) The animal is always restless, excited and nervous.
- (viii) It twitches and carries the tail on one side, exposing the valva.
- (ix) There s a slight rise in body temperature.

Activity five

-With the help of your teacher, seek permission and arrange to pay a visit to a farm that has animals.

- With your teacher's guidance, walk around, look out for any animal on heat.[Remember to keep silent and maintain peace as you carry out this investigation].
- If any animal[s] is / are sighted, have a closer look.
- Discuss each sign as you take note [if no animals are on heat, try another farm or try the same farm another day].

Signs of pregnancy in cattle

- The cow doesn't go on heat 21 days after mating.
- There's a distention (bulging) of the belly.
- The udder tissue gets well developed.
- The flanks get sunken as gestation lengthens.

Activity six

With teacher's guidance, pay a visit to a farm that has cattle.

- Ask the stockman to help you identify pregnant cows.
- Take note of signs of pregnancy that are observable on the selected animals.
- Find out about special attention given to pregnant animals on this farm.
- Summarize your findings into a report.

Care of the cow during pregnancy

1. **Drying off:** - When the animal has been lactating it becomes pregnant, the farmer should stop milking at 5- 6 months of pregnancy.

Aims of drying off.

- (i) To restore the udder tissue by next lactation.
- (ii) To replenish the mineral such as calcium and phosphorus that was depleted.
- (iii) To enable the cow herself to gain weight and energy for the next calving.
- (iv) To cater for the extra nutrient demands of the growing foetus.

- (2) **Feeding:** -the animal should be well fed in the first four months after conception to enhance rapid foetal growth and development.

- (3) **Steaming up.** It's the practice of feeding the animal on nutritive pasture and special protein concentration between 4- 3 months before calving.

Importance of steaming up.

- (i) It provides nutriment for the growing foetus.
- (ii) Stimulates growth and repair of the udder tissue.

- (iii) It provides extra nutrients for the pregnant animals for its body building before calving.
- (iv) It provides nutrients for milk synthesis.
- (v) Prevents nutritional disorders such as milk fever before calving.
- (vi) Provide big room for exercise.
- (vii) Provide mineral supplements such as leaks to deficiency diseases.
- (viii) Heifers should always be brought to the milk paddocks to get them used to it.
- (ix) Provide enough facility for resting.

Questions

1. What do the following terms stand for?
 - [a] Spermatogenesis.
 - [b] Lacto genesis
 - [c] Parturition
2. Where do we find the following glands?
 - [a] Adrenal cortex.
 - [b] Pituitary

What shouldn't be done to pregnant cattle?

1. Don't allow them to walk very long distances.
2. Don't mix bulls with pregnant cows because they can knock or mount them, leading to abortion.
3. Don't scare or beat up pregnant animals.
4. Pregnant cows shouldn't be dipped, they should only be sprayed.

Diagnostic questions.

1. [a] Draw a labelled diagram of a male reproductive system.
[b] What are functions of the labelled parts?
2. What is standing heat?
- 3; List the functions of the following hormones and their sources. [Place of secretion];
 - Progesterone
 - Leutenising hormone
 - Oxytocin
 - Oestrogen
- 4 How can you tell that your female animal is pregnant?
- 5 Discuss the factors that make some female animals infertile.
6. Of what importance is drying off.
7. Differentiate drying off and steaming up
8. What types of care is given to pregnant farm animals.

Signs to show that the cow is about to deliver

- (i) The valva gets enlarged and releases a clean mucus fluid.
- (ii) The udder is excessively enlarged and a whitish fluid is released from the teats.
- (iii) The belly is seen to be extra-large and the animal appears very heavy.
- (iv) Valva muscles are slackened and pin bones widened.
- (v) The cow usually isolates herself.

Care during calving

Provide bedding materials for the animals and invite a vet. Personnel to assist in case of any difficulty. However the animal should be left to calve down on its won.

Care for the calf up to the time of weaning

1. After parturition, assist in removing mucus from the nostrils and mouth.
2. Let the dam dry up the calf by leaking it or you can use some straw to do the same.
3. If the calf is not breathing properly do some massaging on ribs and chest or twitch the nostrils using straw.
4. Disinfect the naval cord with iodine tincture.
5. Give the calf colostrums for the first 4 days.

N.B:- Colostrum is the thick, creamy, yellowish milk given out by the dam within the first 4 days after giving birth.

Importance of colostrums to calves

- Its very easy to digest by the calves
- It contains anti-bodies that impart immunity to calves.
- It contains laxative and purgative substances that assist to remove the sticky feaces (meconum) from the gut.

LIVESTOCK MANAGEMENT PRACTICES

In order to get good products or increase on the number of animals on the farm , Livestock farmers have to carry out good routine rearing practices. These practices include feeding, breeding , identification , debeaking, dehorning , shearing , tooth clipping, culling, castration, good management during parturition, pest and disease control. Some of these are carried out on a daily basis, others on a monthly basis, yet others on an annual basis.

1. Feeding

Animals kept on a farm must feed on a daily basis. Some animals however, are fed in special ways. Some of the special ways of feeding farm animals are;

Flushing

This is a feeding practice carried out in lambs and pigs. Towards the oestrus period, Such animals are fed on extra nutritious feeds before they are served , to ensure that during ovulation , many eggs are released . As a result, when fertilization takes place, many off springs are produced.

Reasons for flushing

- [a] To increase the number of litter during furrowing.
- [b] To enable ewes produce twins during lambing.
- [c] To prepare ewes and gilts ready for mating.
- [d] To some extent reduce barrenness in ewes.

Steaming up

During pregnancy, expectant animals are fed well especially towards parturition. The feeding of farm animals with extra nutritious feeds two months before parturition is referred to as steaming up . The feeds given should be rich in proteins and carbohydrates.

Reasons for steaming up

- [a] To meet the nutritious demands of the unborn foetus
- [b] To enable production of enough colostrum after calving.
- [c] To accustom the in calf heifer to a milking par lour.
- [d] To enable animal put on weight.
- [e] To prevent twin lamb diseases
- [f] To increase milk production cattle.
- [g] To make expectant mothers strong so that parturition is easily carried out.
- [h] To enable production of heavy and healthy young ones
- [i] To stimulate the development of mammary glands.
- [j] To prevent Nutritional disorder (milk fever)
- [k] Repair of body.

Creep feeding

This is a practice of feeding piglets on nutritional feeds from 10days to about two months of age .creep feeds in the form of pellets. They are only given to piglets because they are expensive. A special room called a creep area to which only piglets can reach through a small entrance is made.

Methods used in feeding calves include;

- (i) Single sucking
- (ii) Multi sucking
- (iii) Bucket feeding
- (iv) Bottle feeding

i. **Multi-sucking:-** It involves the farmer having a number of lactating cows then selects one to feed the many calves, reserving milk from other dam for sale. The one used to feed the calves is called the nurse cow.

ii. **Single sucking:-** It is when the calf is freely allowed to suckle its dam (mother).

iii. **Bucket feeding:-** The calf is separated from its dam and trained to drink milk from a bucket.

Training is done by allowing it to lick the fingers that have just been dipped in the milk. In the process the fingers are gradually lowered back into the bucket until the tongue gets in touch with the milk inside. This is done once or twice and the calf will learn to drink by its self.

Advantages of bucket feeding

- Reduces incidence of scouring in calves.
- There is better management of milk produced by the dam.
- Over feeding or under feeding is avoided.
- It enables calves to be weaned as early as possible.

Disadvantages

- It is quite tiresome.
- There is a risk of feeding the calf on too hot or too cold milk.
- A dirty bucket may promote disease transmission.

iv. **Bottle feeding:-** Calves are allowed to suckle warm milk contained in bottles filled with ripples.

2. Parasite and disease control practices.

Parasites and diseases cause great loss to many livestock farmers. They lead to death of animals and also increase on the cost of production. Parasites and disease control measures include ; vaccination, deworming, hoof trimming , docking, dipping and dusting.

Vaccination

This is the routine practices carried out in raising livestock to prevent diseases. Vaccination is the introduction of vaccines either orally or intravenously to induce immunity. It is also called inoculation. Vaccines can be bacterium, virus or their toxins which are weak and can not cause diseases to the animal once introduced . The antibodies produced by the animal after inoculation help to fight against that particular disease once there is an outbreak.

Immunity arising from introduction of vaccine into the body is called active immunity. It is important to note that vaccination should be done on a regular basis to prevent outbreaks. Routes for vaccination include intravenous, intramuscular, eyes, nostrils (eye/ nose drops).

Precautions taken when vaccinating

- Do not mix two vaccines together when administering.
- Avoid exposure of vaccines to high temperatures during transit.
- Store vaccines in deep freezers, refrigerators or ice in flasks.
- Use distilled water when mixing vaccines.
- Vaccination should be done in the cool hours of the day.
- Vaccinate all animals / birds at once.
- Use clean and disinfected equipment.
- Follow manufacture s instructions regarding use of vaccines.
- Give antibodies/ vitamins to animals for 3 days to reduce stress after vaccination.
-

Deworming

Deworming (drenching) is a routine practice carried out on the farm to overcome internal parasites. It is the giving of drug to animals orally using a drenching gun or bottle. Control internal parasites include tapeworms, liver flukes and round worms. The animal to be drenched should restrained , the mouth opened , then the drug gently and slowly released into the mouth. Bloat however which is a digestive disorder can be controlled by giving an oil drench / vegetable oil.

Dusting

This is a common practice in the control of external parasites such as mites, mange and lice. The animal is dusted with a powdered chemical which later kills the parasites.

Dipping

Dipping is the total submergence of the animal into a dip containing acaricides. External parasites such as ticks, mites and lice can easily be controlled by this practice. Dipping is usually carried out in a plunge dip. Acaricides commonly used in dips include supona, baytiol and bacdip. Small animals like goats and sheep are dipped in a shallow dip known as machakos dip. Some times, farmers can control external parasites by spraying with chemicals. The chemicals are mixed with water put in a sprayer and sprayed on to the animals bodies. Alternatively, acaricides can be poured directly on the back of the animal's body. The chemical then spreads all over the body. In such cases however, farmers must be sure that the right chemical is being used. Spoton and pygrease are some of the acaricides that are poured directly on the back of the animal to control external parasites.

3. General management practices

Hoof trimming;

Hoof trimming is the cutting short of hooves that have grown too long and out of shape. The practice is carried out using a hoof trimmer or sharp knife. Animals kept in doors are prone to hooves growing out of shape.

Docking

Docking is a common practice in sheep rearing. It is the removal of tails from lambs. Docking is carried out at the age of 1-3 months. It is done by use of a sharp knife or a rubber ring. In the case of a knife, the tail is cut off and a hot iron passed over to seal off the blood vessels so as to prevent over bleeding. On the other hand, if the ring method is used, the strong rubber ring is used. The strong rubber ring is stretched using an elastrator and placed at the base of the tail. Later on, the tip of the tail falls off. Docking enables the mating process to become easy for the ram.

Culling

The removal of unproductive animals from the farm is culling and it is based on old age, failure to conceive or to mount, slow growth rate, bad habits such as egg-eating, poor dairy temperament, etc. The culled animals are sold off and slaughtered.

Round-up

This is the practice of bringing together all animals especially cattle, goats and sheep on the farm regularly. This is performed for the following reasons.

- (i) Physical counting of the animals.
- (ii) Cull unproductive animals.
- (iii) Carry out vaccination.

Grooming:

This cleaning of hair coat of an animal by brushing using a brush. The hind quarters are usually brushed. Grooming is performed for the following reasons.

- General cleanliness and appearance.
- Massage waste and stimulate the cutaneous blood and lymph circulation.
- Remove waste products, scurf and loose hair.
- For clean milk production
- To facilitate mating by preventing hard dry crusts from bruising the penis.
- To keep the skin loose and pliable.

Breeding practices;

These are carried out on a farm among animals that have reached sexual maturity. It is meant to increase the number of animals and therefore, increase production..

Breeding involves allowing female animals to mate with a male.

Crutching

This removal of fleece (wool coat) from the area under the tail and hind legs in sheep. In females, this fibre gets attained when urinating. The wet fleece is known to cause skin burning and irritation to the animal. Also attracts flies.

Raddling.

This is the practice of identifying animals that have mated with females in a flock. It is achieved by attaching an apron with a particular dye on each male animal. Each animal has a different colour of the dye and this colour is tainted on females it mates with. The purpose of raddling is to attribute the good or poor performance to given male animal for example

- (a) All females returning to heat and were mated by a given male means the latter is poor and should be culled.
- (b) Offspring that have good trait and were from a particular male means the latter should be retained.

Tupping and serving.

Tupping is the practice of feeding ewes properly prior to mating. Very fat animals are fed on poor pastures or grazed indoors to reduce the fat while thin ones are grazed on good pastures to increase weight. Tupping improves conception, lambing percentage and feeding conversion efficiency.

Serving is the process through which female animals on heat receive semen. It could be from a male animal of the same species, natural service or by artificial insemination means.

Ringing

In sheep shearing is a common practice but at times the wool is stained. In addition to crutching, wool in other areas which is stained is also removed. The latter is known as ringing. This additional shearing is done to improve on quality of wool and reduce on incidences of blowfly strikes. It is however limited to specific times or areas of the animal's body

DIAGNOSTIC QUESTIONS.

1. What is rounding up of animals?
2. What is the importance of rounding up animals?
3. Give the reasons for steaming up farm animals.
4. Differentiate between the following.
 - Hoof trimming and docking.
 - Dehorning and castration
5. Why are the following practices done in livestock management?
 - Crutching in sheep
 - Raddling in sheep
 - Castration
 - Dehorning.
6. Describe how you can castrate a calf using the surgical method.
7. How can a calf be dehorned using the chemical method?

4. Identification

It is the introduction of identification marks on animals.

Importance of identification

- (i) Facilitates proper record keeping
- (ii) Facilitates proper feeding of animals
- (iii) Enables the farmer to trace cost or strayed calves.

Methods of identification

- (a) Metal or strong plastic with numbers printed on them.
The tags are fixed on calf's ears by tagging application.
- (b) **Tattooing**: - It involves printing the desired mark on the inside of the ear using tattooing pliers and ink.
- (c) **Ear notching**: - It involves making V- Shaped cuts at specified places along the edges of ears by means of very sharp scissors or pincers.

N.B:- Very small notches are easily closed up or hidden by hair while big notches lead to ear deformation.

(d) **Branding:-** A hot iron is used to impress a permanent mark on the hide or skin of the animal.

N.B:- Brand marks should be placed on parts of the animal that so not damage the skin or hide e.g.

- Top part of the hump
- Thigh
- Cheek
- Knee
- Hocks
- Jaws

Other methods include

- Leg banding (for poultry)
- Neck lacer (for goats and cattle)
- Hoof cutting
- De-horning (for cattle, goats etc)
- Tail cutting (for sheep)

2. Dehorning

It is the practice of removing horn buds and from livestock.

Importance of dehorning

- (i) It facilitates easy handling of livestock.
- (ii) It facilitates easy transportation of animals.
- (iii) Provides space in places like kraals, pens and milking shades.
- (iv) It reduces the risk of injuring other animals
- (v) It reduces wastage of body nutrients in horn development.
- (vi) To some people, polled animals are more appealing.

Methods used in dehorning

- (a) Chemical method
- (b) Hot iron method
- (c) Use of elastrator
- (d) Wire and saw method
- (e) Natural or breeding method

(a) Chemical method

It is done to calves 3 – 10 days old. Chemicals used include caustic potash (KOH) or caustic soda (NaOH)

Procedure

- (i) Dip off the hair surrounding the horn buttons.
- (ii) Surround areas with some Vaseline or grease to protect the skin and eyes from the chemical.
- (iii) The caustic stick is moistened and the chemicals over the horn button till the skin begins to slip and become red (Take care to avoid bleeding).

N.B:- The calf should be separated from others to avoid being licked.

- The calf should be kept away from rain.

(b) Hot iron methods:- It is done on calves above 10 days of age. A hot iron is placed at the top of the horn button for about 10 seconds. Heat will kill its growing cells.

(c) Use of elastrator:- An elastrator is a vet. Tool used for stretching rubber rings.

The rubber ring is stretched and strapped at the base of the growing horns. Small horns off after 3 – 6 weeks while large ones can take beyond 2 months.

(d) Wire and saw method:- A metallic rough surface wire or a dehorning saw can be used to cut the horns well at the base. This is suitably done on long horns.

3. Castration

It is the removal or disfunctioning of the testicles of a male animal.

Importance of castration

- (i) It prevents the breeding of animals with poor traits in the kraal.
- (ii) It avoids in-breeding in the herd.
- (iii) It makes the animal docile and easy to handle.
- (iv) It avoids transmission of sexually transmitted diseases in the herd.
- (v) Animals grow and fatten quickly.
- (vi) Castrated animals produce beef of very high quality.
- (vii) It prevents bad odours (smell) in male animals especially goats.
- (viii) It makes animals suited to work e.g. cultivation and transportation.

- (ix) Castration improves on the quality of wool in sheep.

Methods of castration

These include;

- (a) Surgical method
- (b) Burdizzo method
- (c) Elastration method

(a) Surgical method

A sterilized surgical knife or blade is used to slit the scrotal sac to form an opening through which the spermatic cords are pulled out. The cords are cut and ligatured to prevent blood and nutritional supply to the testicles. The testicles will shrink and be disfunctioned in a short period of time.

N.B. Tar, healing oil or an anti-biotic should be applied at the wound soon after the operation.

Advantages of surgical method

- Its quite cheap
- its quick

Disadvantages

- It can lead to great loss of blood
- There s a risk of infection.
- It requires technical knowledge and experience.

(b) Burdizzo method

A burdizzo is a blunt edged tool used in castration.

The spermatic cords or crashed by forcefully pressing the jaws of the tool well at the base of the scrotal sac.

The method is bloodless, quick but quite expensive.

(c) Elastrator or rubber ring method

The rubber ring is stretched by an elastrator and strapped just at the base of the scrotum. The scrotum and the testis inside will shrink and drop off after about 2 weeks.

4. Restraining animals

It is the hindering of movement of animals.

This can be done by means of;

- (i) Crush
- (ii) Casting

A crush is a strong wooden structure in form of a fence, for confinement of animals.

Casting involves throwing the animal on the ground using ropes or a healthier. Restraining is important when carrying out operation like branding, treatment, slaughtering, and inspection, dehorning and taking body temperature.

DAIRY MANAGEMENT

The main reason why most farmers keep dairy cattle is the production of milk among others. Milk is the white nutritious liquid produced by a cow (lactating animals) after successful parturition. Usually after calving, the stomachs of these calves are not fully developed and largely depend on this liquid until when solid foods are introduced.

The lactating cow produces milk from the time of calving down to the period of drying off. A good cow should produce adequate amounts of milk during the lactation period. In order to produce enough milk, for a long time, the cow must be fed well and managed well.

Characteristics of a Good Dairy Breed.

- It is wedge-shaped that is thin at the head and wide at the rear.
- Having a pronounced milk vein such that there is a good supply of blood to the udder.
- Well spaced teats which are long enough.
- Well attached udder (not pendulous).
- Should have even sized teats.
- Large capacity of udder.
- Should be docile (have good temperament).
- Have a long lactation period.
- Should be able to produce a lot of milk.
- The teat orifice should not be large.

Benefits of Dairy Farming.

- The farmers will have a stable source of income and employment for the family.
- Cattle are able to convert fibrous materials which would be useless into high feed value products like milk and meat.
- They are more efficient producers unlike beef cattle, pigs or poultry.
- Source of farmyard and manure.
- After their production period, they are fattened to produce good quality beef.

Limitation of dairy farming.

1. High labour requirements
- 2 Requires a lot of capital investment.

3 Milk is highly perishable.

4 Calls for plenty of skills, knowledge and modern equipment.

5 Risk levels are high.

Milk composition

The composition of milk in any dairy cow is largely determined by many factors such as breed, season of the year, type and amount of feed, stage of lactation and temperament. Milk is composed of water, fats, proteins, sugars, minerals and vitamins.

The percentage composition in any breed is approximately;

Water 87.6%

Minerals (ash) 0.7 %

Proteins 3.2%

Fats 3.7%

Sugar 4.8 %

Proteins, mainly casein, are formed by combining amino acids, sugar (lactose) formed from two simple sugars glucose and galactose and fats formed from glycerol and acetic acid.

Qualities of Good Milk

- Good milk has a good flavour.
- Clean without foreign materials.
- Good keeping quality can stay for a long time without going bad.
- Safety to the consumer such that it has no germs to cause disease to man for example Tuberculosis.
- Nutritious containing all food values.

Why Milk is highly perishable

1. Contains fats which easily go rancid.
2. It contains many nutrients essential for multiplication of a wide range of micro-organisms.
3. Contains a lot of water.
4. Can easily absorb smell from the surroundings.
5. It contains fat, which easily goes bad.
6. It readily absorbs smell and bad odours.

Factors affecting milk yield and composition

1. **Breed of the animal:** - Friesians produce more milk with low butter fat while Zebu produces less milk with more butter fat.
2. **Age of the animal:** - Milk yield tends to increase with age up to either lactation. It remains steady until 10th lactation, after which it begins to decline.
3. **Period of lactation:** - Milk yield increases until the seventh week after which it begins to decline.
4. **Health of the animal:** - Healthy animals, as opposed to diseased animals produce high quality and quantity of milk.

5. **Temperament of the cow:** - Quiet animals are the best milkers. Nervous cows and those that kick about produce less milk.
6. **Feeding of the animal:** - Proper balanced feeding leads to production of good quality and quantity of milk.
7. **Season of the year:** - Cows tend to produce more milk of better quality in rainy season compared to dry seasons, apparently due to presence of young lush pastures.
8. **Oestrous (Heat period):** - Oestrous usually causes a slight restriction in milk yield and composition.
9. **Handling of the animal during milking:** - Gentle treatment of the animal during milking ensures high milk production.
10. **Frequency of milking:** - The more times the animal is milked per day, the higher is the milk yield.

Pasteurization and sterilization of milk

(a) Pasteurization

It is the process of killing micro-organisms in the milk by heating at controlled temperatures that do not considerably change the natural characteristics of the milk.

Objectives of pasteurization

- To reduce the milk micro-organisms to a safe level without destroying the nutrients.
- To increase the life or keeping quality of the milk.

Systems of pasteurization

1. Low temperature holding process (LTH):- it involves heating the milk to above 62°C and holding it there for about 30 minutes, then rapidly cooling it to 10°C.
2. High temperature- short term process (H.T.S.T):- milk is heated to above 72°C and held there for about 15 seconds before rapidly cooling it to 10°C.

(b) Sterilization

It is the process of making milk completely free of micro-organisms by heating to very high temperatures. In this process, the quality of the various nutrients such as protein, vitamins and minerals is considerably reduced.

Methods of sterilization include

1. **In bottle process:** - The milk is heated to above 110°C for about an hour.

2. **Ultra high temperature process (U.H.T):-** Milk is heated to about 150°C for 20 seconds then immediately placed in completely sterilized bottle.

Milk products include cream, cheese, butter, yoghurts and ghee.

Milk synthesis, secretion, Letdown and Hold up

Milk Synthesis.

Milk of the constituents of milk come from the food the cow eats. These raw materials such as amino acids, sugars and glycerols are brought to the udder by blood vessels. The udder has secretory cells found in the alveolus and it is where materials are assembled into milk. The whole process is known as milk synthesis.

Milk secretion

Milk secretion (lacto genesis) begins some few months before calving. This is usually during the steaming up period. Milk secretion takes place in the udder under the influence of prolactin hormone controlled by the anterior pituitary gland. Notably a fall in the body level of progesterone initiates milk secretion and it happens just prior to parturition.

Milk secretion is the release of milk from the secretory cells, into the alveolar cavity, to the duct and then gland cistern. This is controlled by the luteinizing hormone. (L H) Secreted by the anterior pituitary gland.

As the process of digestion and absorption take place, more raw materials are brought to the udder by blood vessels. Therefore milk has to be removed from the alveolar cavities and gland cisterns during the process of milking. This ensures constant milk secretion. The more times the cisterns are emptied, the more milk will be synthesized.

The udder comprises of four quarters each independent of the others and is drained by its teat. It is supported onto the body by strong ligaments and abdominal muscles. The left quarters are separated from the right ones by the medial suspensory ligament. The secreting glands are surrounded by blood capillaries therefore well supplied with constituents of synthesizing milk. In the middle they open into tiny spaces called alveoli and these are lined by cells which secrete the milk.

The various alveoli converge into small ducts then eventually larger mammary ducts which open into the udder or gland cistern. The teat is connected to the gland cistern. At each convergence point is a sphincter muscle which holds milk until a stimulus occurs to the cow.

Qualities of a Good Udder

A good Udder has;

1. Four- well developed spaced teats.
2. Should be soft to touch.
3. Should be big enough to hold more milk.
4. Should not be liable to injection.

The udder



Materials that include proteins, vitamins, fats, urine, simple sugars and water are delivered through the blood to the alveolar cavity. The milk secreting cells limit alveoli extract these materials from blood and combine them through a sequence of biochemical process to provide milk.

Abnormalities of the udder.

1. Blood stains in milk usually due to mastitis.
2. Udder inflammation due to bacteria infections like mastitis.
3. Congestion; udder swells before calving as well as when milking is skipped.
4. Milk letdown failing especially in newly calved heifers.

Milk letdown and hold up.

Milk held in the alveolar cavity and ducts has to move down to the cisterns. The down ward flow of milk from the alveolar cavities, mammary ducts, into the gland and teat cisterns is known as **milk letdown**.

Milk let down is controlled by the hormone oxytocin, secreted by the posterior pituitary gland. In order for oxytocin to be produced, the animal has to be stimulated. The stimulus can be any of the following;

- Washing and massaging the udder with warm water.
- Sight of calf at milking time.
- Approach of milking time.

- Provision of feeds at milking time.
- Sucking by the calf.
- Noise made by knocking of milking utensils.
- Attachment of teat cups onto the teats.

When any of these happens, a message is sent from the udder to the brain and the posterior pituitary gland secretes oxytocin hormone into the blood stream. Oxytocin is pumped to the udder and the effects are the contraction of udder muscles surrounding the alveoli and dilation of the annular fold.

Effects of oxytocin in the udder

- (i) It contracts the alveolar muscles thereby forcing milk through the ducts down to the teats.
- (ii) Stimulates the production of more milk by alveolar cells.

N.B Influence of oxytocin lasts for about 7 minutes thus milking should be done very fast within this time limit.

Milk hold up

However, it is worth noting that once the animal is excited, the opposite occurs, that is, milk hold up. Milk hold up is a situation whereby milk letdown is stopped due to the secretion of an adrenaline hormone by the adrenal gland. Poor handling during milking such as unusual noise, pain due to poor milking techniques and beating, lead to milk hold up (the prevention of down flow of milk from the udder). In other words, under conditions of excitement such as rough handling, strange sound or otherwise, a hormone called adrenalin is produced by the adrenal gland. Adrenalin contracts the muscles of the annular fold thereby preventing the release of milk from the udder.

Thus, for adequate milk yield, it is advisable to have a gentle and quiet handling of the animal during milking.

N.B:- Adrenaline opposes the influence of oxytocin.

Clean milk production.

Milking is a daily routine carried out on a dairy farm. Milking is the process of removing milk from the gland cistern and teat cistern into a container. It can be done by hands or machines. The milking process can conveniently be divided into the following stages;

- (a) Preparation of the milking shed and milking utensils.
- (b) Preparation of the cow.
- (c) Preparation of the milker

Preparation of the milking shed and milking utensils..

- The milking shed should be scrubbed clean before actual milking starts and allowed to dry.
- In case of machine milking, the teat cups and milk storage tank should be washed clean.
- Also ensure that the whole milking machine is in good working condition.
- The feed trough should be cleaned and later filled with concentrate feeds..
- Any material that can taint milk should be removed from the shed.
- The milking utensils such as pails, churns, strainer and strip cup should be washed clean and any dust removed.
- The utensils should be within easy reach.

Preparation of the cow.

- Animal should be allowed to assemble within the milking area in a good time. This allows them to settle down.
- The hind legs are tied with the help of a milker's rope and the udder washed with warm water mixed with a disinfectant.
- The udder is then wiped dry with a clean disposable towel
- The hind quarter is brushed or groomed to remove loose hair or dust.

Preparation of the milker

The milk man / woman should do the following before milking starts.

- Wash hands with soap and dry them with a towel.
- Cut his / her finger nails clean.
- Put on a cap
- Should be healthy and not suffering from infectious diseases such as tuberculosis and typhoid.

Procedure of clean milk production

In order to produce clean hygienic milk on the farm, the following procedures should be followed.

1. Ensure that the milking parlor or shed is cleaned before milking starts.
2. The milking utensils should be washed with a disinfectant and sterilized in the sun to kill germs.
3. Healthy cows which are free from mastitis should be milked.
4. The milker should wash his / her hands and dry them before milking.
5. The milker should cut his or her finger nails short.
6. The milker should put on clean clothes.
7. The milker should put on a clean cap.
8. The udder of the cow is washed with warm water mixed with a disinfectant and dried with clean towel which is disposable to prevent the spread of mastitis.
9. The hind quarters are brushed to remove loose hair and dust
10. Feeds are put in the trough so that the animal is not excited while being milked.
11. A few streams of milk are drained from each teat into a strip cup to detect mastitis. Animal with mastitis should be milked last and their

milk poured away. Draining helps to get rid of first milk which has many bacteria and is also known as stripping.

12. A milk salve (jelly) is smeared onto the teats to reduce friction and cracking of teats.
13. Use clean utensils to avoid contamination of milk.
14. Use milking utensils with smooth inner walls for ease of cleaning.
15. Use aluminum or plastic utensils to avoid contamination.
16. Do not feed cows on silage before and during milking to prevent tainting of milk.
17. Filter milk after milking to remove foreign materials such as flies or hair.
18. Cover the milk well to prevent dust and flies from falling into the milk.
19. Keep milk in a cool place to reduce the multiplication of micro organisms. Where possible, milk can be boiled and allowed to cool down.
20. Wash all the utensils used in the milking process with a disinfectant and put them under the sun to dry. They should be dried on a rack while facing upside down.
21. Keep utensils in a clean store upside down to prevent dust/ dirt settling in them.
22. Scrub the shed clean.
23. Record the milk produced in litres.

Reasons for using a strip cup.

- To detect mastitis in milk.
- To remove milk in Beef Fat content before actual Milking.
- To remove milk high in micro-organisms usually found in the teat cistern.

Activity one.

- Visit a near by farm or go to a school dairy unit and participate in preparing clean milk production.
- Prepare the milking shed and utensils.

Methods of milking.

There are two methods used to remove milk from the udder of the cow and these are; Hand and machine milking.

Hand milking;

The milker squats and ties the hind legs with a milker's rope, washes the udder with warm water and dries it up with a clean towel. He then applies the teats to avoid cracking. The thumb finger is placed along the teat and the index finger closes the top of the teat. Then pressure is exerted on the teat by squeezing the teat rhythmically.

Milk trapped in the cistern is drawn down words into the container.

Avoid pulling the teats during milking as may lead to milk holdup.

The system is quite slow, inefficient and tiresome.

It is however cheap, easier to practice and facilitates easy control of mastitis.

Machine milking involves the use of a milking machine.

Advantages

- It is so quick and works within the influence of oxytocin.
- It improves on quality and quantity of milk produced on the farm.
- It requires less labour.
- There is easier handling of livestock.

Disadvantages

- The purchase and installation of the machine is very expensive.
- The operation of the machine requires technical know how.
- It can lead to a high incidence of mastitis on the farm.
- Power failure can greatly affect the milking process.
- A faulty machine may cause injury to animals.

Activity two

Visit a near by farm and dry to practice hand milking.

Machine milking

A milking machine is common equipment on large dairy farms where hand milking may be possible. A milking machine is composed of vacuum supply unit, the pulsator, the vacuum controller, the teat cup liner and milk receiving unit.

Vacuum supply creates vacuum within the entire system and this is the principle on which the machine works. When the teat cups are put on teats, re put on the teats, the vacuum pump creates a vacuum inside the rubber teat cup liners as well as between the rubber liners and the metal shells. As a result, the vacuum created holds the teat cups in place the teat canal opens up and milk flows out.

The pulsator dries air atmospheric pressure into the chamber between the rubber liner and the metal shell. The air is then drawn into the vacuum system. The pressure created massages the teat and draws milk from it .differences in air pressure occur during pulsation between the vacuum level within the liner and the normal air pressure outside the liner and this causes it to shrink.. The end result is the re- establishment of the vacuum level and milk is drawn from the teat canal. This is the actual milking phase.

When massaging is not properly done by the teat liner, injury to the teat is likely to occur.

In order to avoid injury to the animal. The pulsation ratio (Pr) should be set according to the manufacturer's instructions. PR is the time the inflation is in the milking phase compared to the resting phase. The vacuum controller is a valve in the vacuum supply unit, which performs the following during milking.

1. Regulates the amount of air in the vacuum level so that it is not high or low. Too high vacuum causes injury to the teats and at a low vacuum level, milking will be slow and teat cups will fall off.

2. The milking unit is made up of four teat cups, pulse tubes and milk collecting tubes. The teat cups are attached on to the on the teats and once the machine is switched on, there is synchrony between the vacuum supply unit and pulsator. If the machine is in good working condition, milking will start (that is resting phase and milking phase)

3. Milk receiving unit. It is made up of glass and calibrated. Milk is directed through the milk line via the pump into the milk storage tank.

Machine milking has the advantages of clean milk production, saving labour and it is quick. However, costs of installment are high, faulty machines can injure the animals, there are higher chances of mastitis spread through teat cup and power failure can affect milking.

Milking Techniques

- Before milking starts, wash the udder with warm water, dry it with a towel and provide the cow with dairy meal.
- Tie the hind legs with a milker's rope.
- Wash hands and dry them with a clean towel.
- Squat or sit on a milker's stool on the side of the cow near the udder.
- Apply milk salve on the teats, do not use water, milk or saliva to lubricate the teats
- Rinse your hands with clean water.
- Draw streams of milk from each teat into a strip cup to detect mastitis. Animals with mastitis should be milked last and milk poured away.
- Place the thumb finger along the teat and index finger above the teat and squeeze rhythmically downwards. Avoid pulling teats.
- Milk quickly but gently within 5-8 minutes to maximize the effect of Oxytocin.
- Strip the udder to get the last milk by massaging the udder quarters as far as possible progressively and squeezing out the milk.
- Avoid exciting the animal during milking.

1. HIDES AND SKIN PRODUCTION

Hides and skins are an important export commodity of livestock. They are used in the manufacture of products like hand bags, shoes, carpets, covers and sofa sets.

A hide can be described as one obtained from big animals such as cattle, buffaloes, elephants, giraffes etc. while a skin is one from small stock such as goats, rabbits etc.

Factors that can affect the quality of hides and skin

1. Damage during animals life time (pre-slaughter damage)

- (i) Injuries due to coining and flogging of the animal
- (ii) Injuries due to fighting and congestion among animals.
- (iii) Injuries and bruises due to spied structures like barbed wires and spray races.
- (iv) Damage caused by diseases such as ring worm.
- (v) Damage due to parasites such as mites and ticks together with birds.
- (vi) Bad branding; i.e. placing brand-marks on useful parts of the skin.
- (vii) Bad roping e.g. when a rope or wire is tightened, the neck or any part where it causes damage or injury.

2. Damage during slaughter:-

- (i) Bad casting and dragging of the animal on sharp objects like stones can damage the skin.
- (ii) Incomplete bleeding encourages bacterial growth on the skin.
- (iii) Careless skinning or flaying can lead to piercing of the skin especially when using sharp knives.
- (iv) Delay in skinning can also damage the skin by hardening.

3. Damage after slaughter (post slaughter damage)

- (i) Direct exposure of skins to sunlight encourages cracking of the skin during drying.
- (ii) Contact with soil leads to petrification.
- (iii) When rain collects on the skins, they get spoilt.
- (iv) During transportation damages can be due to poor handling, loading and off loading.
- (v) Fraudulent practices such as leaving skins outside overnights to weigh heavier prior to selling the next day.

How to reduce damage and improve quality of hides and skins

- (i) Branding should be done on the right parts such as the hump, thigh, front legs, ears and jaws.
- (ii) Animals should be dehorned to avoid injuring each other.
- (iii) Animal parasites such as ticks should be controlled on the farm.
- (iv) Slaughtering places should be free of all sharp objects.
- (v) Casting should be done carefully and avoid dragging the carcass on the ground.
- (vi) Bleeding of the carcass should be satisfactory.
- (vii) Flaying or skinning should be done immediately after slaughtering.

- (viii) Animals should be given plenty of water before slaughter as this makes skinning easier.
- (ix) Avoid using so sharply pointed knives in skinning.
- (x) Skins should be dried in shades by air circulation.
- (xi) Storage houses should be so clean, water proof and dry.

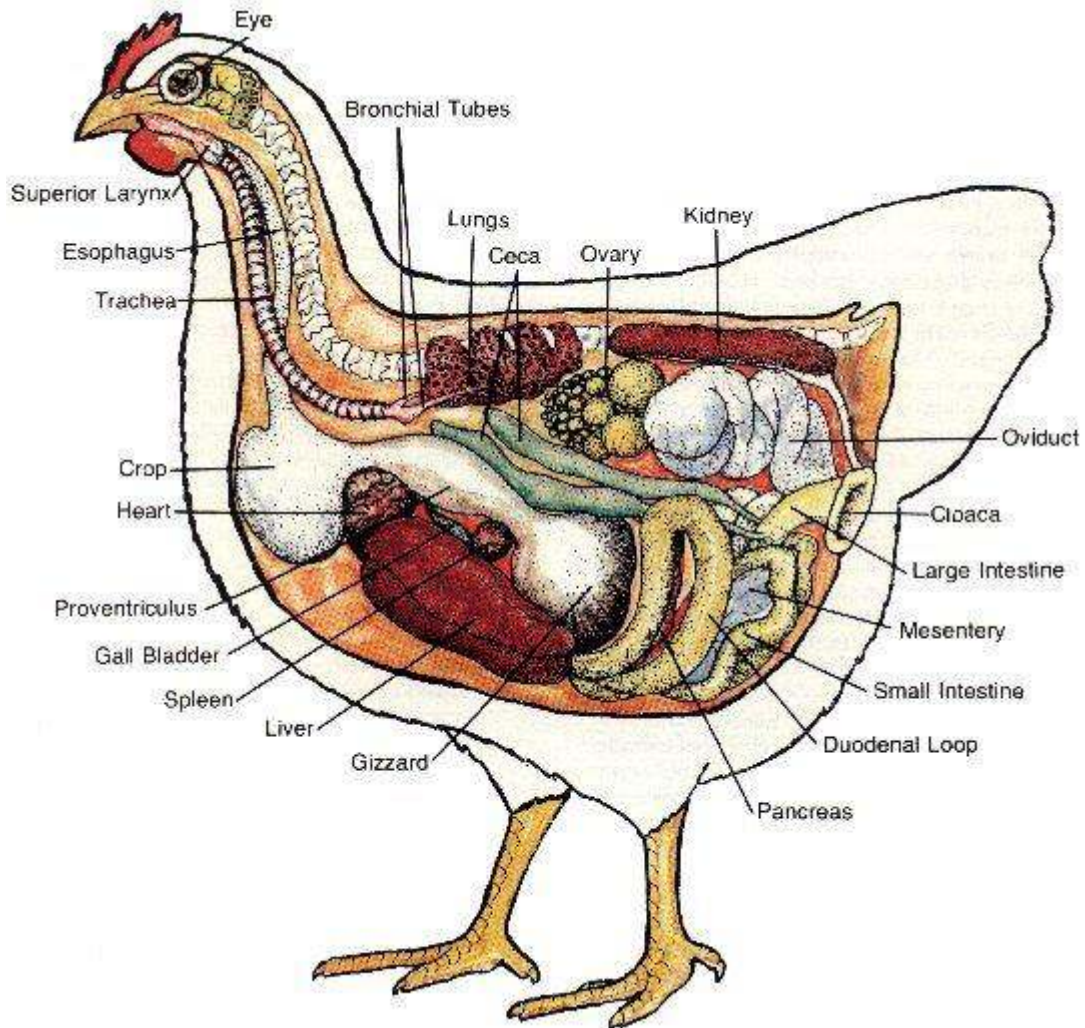
POULTRY PRODUCTION

Poultry is the system of keeping or rearing birds.

Advantages of poultry keeping compared to other enterprises

1. It does not require a large piece of land so can be introduced on the farm as a diversification enterprise.
2. It gives faster returns and profits.
3. It provides many areas of specialization such as sale of eggs for hatching, table eggs, capons, day-old chicks and meets birds.
4. Chicken eggs and meet provide more proteins in diet.

The fowl (parts of a fowl)



Terms related to poultry production

- (i) **Cocks:-** An adult male fowl
- (ii) **Hen:-** An adult female fowl
- (iii) **Cockerel:-** Young male fowl
- (iv) **Pullet:-** A young female fowl
- (v) **Chick:-** A young fowl less than 2 weeks old
- (vi) **Brooder:-** A shelter used for raising chicks to 6 weeks of age.
- (vii) **Incubator:-** An appliance for hatching eggs without a hen.
- (viii) **Capon:-** A castrated fowl
- (ix) **Caponisation:-** The process of castrating a fowl
- (x) **Candler:-** Device used for checking egg quality and fertility
- (xi) **Culling:-** Removal of poor quality birds out of the flocks

Types of chicken

1. **Layers:-** These are kept for egg laying. Example of breeds kept for this purpose include:-
 - (a) **White leg horn:-** These are light birds, white in appearance. They originate in Italy.
 - (b) **Light Sussex:-** It is white with black markings. It originates in the UK.
2. **Broilers:-** These are heavy birds kept for meat production. They are also called table birds. Examples are;
 - (a) **New Hampshire:-** They are lightish red brown birds weighing 4 kg for cocks and 3kg for hens. They originate in the U.S and are good meat producers.
 - (b) **Rhode island red:-** They are dark brown birds with yellow legs. They originate in the U.S cocks weigh 4 kg and hens 2.5 kg.
 - (c) **Australope:-** They are black heavy birds originating in the U.K. cocks weigh 4 kg and hens 3 kg.
3. **Dual purpose breeds:-** These produce good meat and eggs as well. Examples are Rhode Island Red and the light Sussex. Many indigenous breeds in E. Africa are dual purpose.

SYSTEMS OF POULTRY KEEPING

They include;

1. Free range system
2. Deep litter system
3. Battery cage system
4. Fold system

1. Free range (open range) system

Birds are left to roam over a wide area which has a perimeter fence of wire netting. Birds are provided with houses for sleeping at night. There should be plenty of shade and grass for feeding. About 200 – 300 birds are kept per hectare.

Advantages

- (i) Birds eat a variety of food e.g grass, seeds and insects which may not be
- (ii) It is very cheap because no special shelter and feeding is provided by the farmer.
- (iii) Birds get plenty of exercise and thrive better.
- (iv) Birds have access to plenty of sunshine and this improves their health.
- (v) Manure is well spread all over the field.

Disadvantages

- (i) Birds are exposed to the risk of predators like kites, foxes and wild cats.
- (ii) Over crowding can lead to worm infestation.
- (iii) There is easy spread of disease among birds.
- (iv) It requires a large piece of land.
- (v) Eggs can be laid and get lost in the field.

2. The deep litter system

Birds are kept in well ventilated building on a hard floor with 15 – 30cm of plant material called litter. Litter can be wood shavings, saw dust, chopped grass, oat husks, coffee husks, and dried leaves or crushed maize cobs.

Qualities of good litter

- Should be soft enough for good comfort
- Should be quite warm.
- Should be dry and able to absorb moisture
- Should be thick enough (above 15 cm thick)
- Should be of plant origin
- Should be free from parasites and dangerous insects.
- Should not crack loud when stepped upon
- Should be easy and light for birds to scratch
- Should always be clean and free of pathogens (germs)

Food and water containers together with perches and communal nestings are always provided in the house.

Advantages of the deep litter system

- (i) It economizes resources
- (ii) Birds are protected from extreme conditions such as rain and sunshine.
- (iii) It is easy to protect birds from disease outbreak.
- (iv) Incidence of cannibalism, feather plucking and toe pecking is reduced since each bird is busy scratching the litter.
- (v) Manure is easily collected and used as fertilizer.
- (vi) It is easy to keep the production records.
- (vii) Less labour is required in egg collection.

Disadvantages

- (i) Feed hoppers and water containers can be contaminated by litter and droppings.
- (ii) Parasites can accumulate in the litter if not periodically turned.
- (iii) Eggs can be tainted if the nesting boxes are not clean.
- (iv) The cost of construction of shelter is high.
- (v) It is also quite costly to feed and look after birds.

3. Fold units system

Birds are usually reared in flocks of 20 housed in movable shelters called folds. Each bird is a space of about $\frac{1}{2}$ sq m. the units are moved to some fresh grassland every day. It is suitable for birds about 8 weeks of age.

4. Battery system

Birds are kept in wire cages. The cages in tiers and tiers can be two or three on top of one another. Water and food containers are usually fitted on the cages and usually filled by hand.

Assignment

Outline the advantages and disadvantages of;

- (i) Fold units system of poultry keeping.
- (ii) Battery cage system.

Housing poultry.

Does it make good sense to house chicken? Yes. Because housing;

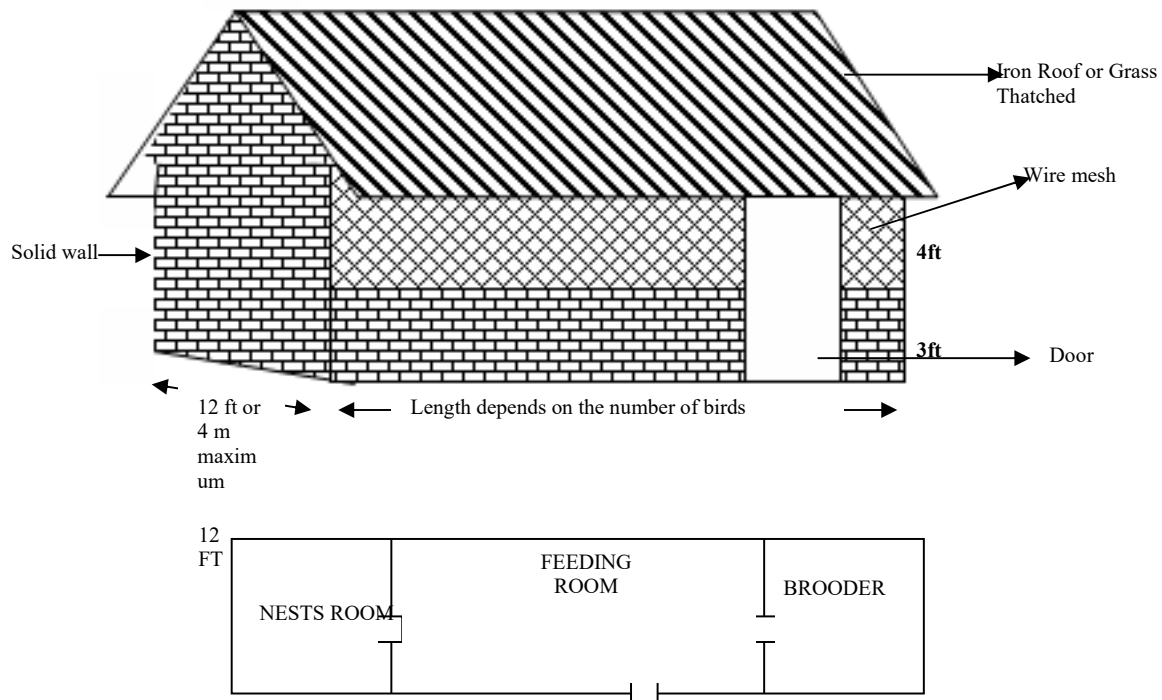
Facilitates warming especially to chicks, Minimizes predators, Minimizes theft, Provides convenience for egg laying, Provides convenience for egg incubation, Disease control is easier And enables utilization of chicken manure.

Good poultry house should ensure the following aspects;

Maximum ventilation, Sufficient and even distribution of light. Sufficient and even distribution of heat, should be water- proof (should not leak), cleanliness and friability (dryness & looseness) of litter, Have perches as birds naturally prefer resting off the ground. (Roosting)., Should be strong enough not to collapse on the birds in case of a

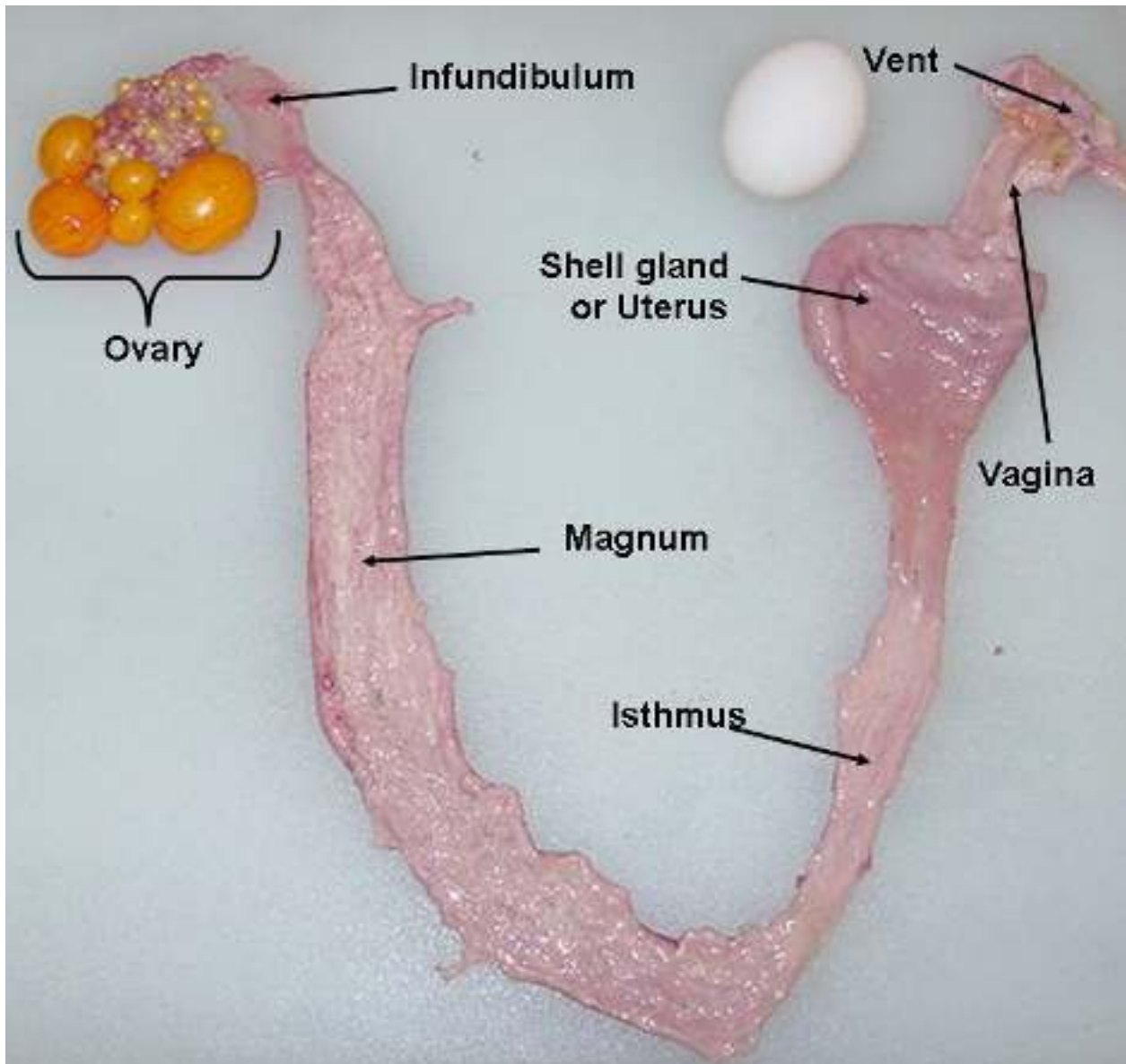
storm, and also protect against petty thieves and should provide at least 1 ft squared floor space per bird

A Poultry House



REPRODUCTION IN POULTRY

Reproduction system of a fowl



Process of egg formation

It takes place in about 24 to 26 hours.

Ovary: - It is where the formation of the ova (eggs) or egg Yolk takes place. (Ovary also secretes a hormone and organ responsible for size and colour of the comp) when the yolk is mature, it ruptures and moves downward.

Infundibulum (funnel):- It receives the yolk from the ovary. It is also responsible for formation of the chalazae. The egg stays here for about 15 minutes.

Magnum: - In the magnum, a thick layer of albumen (egg white) is added to the yolk

Isthmus: - Soft shell membranes are added to the egg here. Water, minerals and a thin layer of albumen here. The egg stays here for about 1 hour.

The uterus (shell gland):- Its responsible for secretion and formation of the hard calciferous shell which is added to the egg. Pigmentation of the egg and albumen formation is completed. The egg spends 18 – 22 hours hatching.

Vagina:- Its where the egg is inverted and comes in the normal position. Vaginal fluids are also secreted to reduce friction.

Structure and parts of the egg

Functions of the parts

- (i) **Egg shell:** - It is a hard outer cover that protects the egg. The shell also contains pores for egg ventilation.
- (ii) **Air space:** - It keeps air in the egg.
- (iii) **Albumen:** - Contains food materials such as vitamins, water, proteins that support the growing embryo during incubation.
- (iv) **Chalazae:** - These are white strands that hold the yolk at the centre.
- (v) **Yolk:** - It is a yellowish substance, containing iron, vitamins, fats, minerals and water. All these provide nutrients to the embryo.
- (vi) **Germinal disc:** - It develops into embryo during incubation.

Assignment

State the similarities and differences between rep. system of a bird and that of a farm animal.

Qualities of a good egg for hatching

- (i) Should be of a medium size. Too big or too small eggs do not hatch properly.
- (ii) It should have an oval shape.
- (iii) It shouldn't have a cracked shell.
- (iv) Should have clean, smooth and thick shells.
- (v) Should have a relatively small air space.
- (vi) Shouldn't have abnormalities such as a blood spots, meat spots and double yolk.
- (vii) It should be fertilized.

Abnormalities in eggs

- 1. **Blood spot:** - A drop of blood can be shed into the yolk at ovulation.
- 2. **Meat spot:** - A piece of tissue may be torn from the ovary at the time of ovulation and it comes down with the yolk.
- 3. **Soft shelled eggs:** - This can result from premature egg laying or poor nutrient.
- 4. **Thin shelled eggs:** - This can be due to disease or nutritional def- especially of vitamin A, calcium or phosphorus.
- 5. **Abnormal colour or smell of yolk:** - This can result from poor quality feeds.
- 6. **Double yolks:** - It can result from a physiological defect of the oviduct.

Egg incubation

Egg incubation refers to provision of appropriate conditions that can lead to hatching of the eggs.

Conditions necessary for proper egg incubation

- 1. **Fertilization:** - The egg should be fertilized to facilitate formation of embryo.
- 2. **Egg turning:** - Eggs should always be turned to avoid embryos sticking on one side of the egg shell.
- 3. **Ventilation:** - Cool air should be allowed to pass over the eggs to facilitate respiration of embryos.
- 4. **Warm temperature:** - A temperature of about 35oc – 40oc is recommended.
- 5. **Humidity:** - A moderate level of humidity especially at hatching is required. At hatching, chicks crack egg shells and emerge out.

Systems of incubation

- 1. **Natural incubation:** - This is when a broody hen is used to provide warmth and other necessary conditions.

2. **Artificial incubation:** - It is where an incubator is used. All the conditions i.e. temperature, humidity, ventilation and constant turning are physically met by the incubator.

Components of the incubator

BROODING

Brooding is the care and management of chicks to the age of 6 or 8 weeks.

A brooder is a special form of shelter used in raising chicks.

How to prepare a brooder before introduction of chicks

- The house should be scrubbed with a hard brush and plenty of water.
- The house should be disinfected with suitable disinfectants.

- All equipment such as water troughs and food containers should be disinfected and sun dried.
- A heat source should be provided. This can be a charcoal stove, kerosene lamp, electric lamp etc.
- A confinement of about 60cm high should be placed round the heat source for protection of the chicks.
- Suitable soft litter should be provided.
- The litter should be covered with a paper to prevent being eaten by the chicks.
- A thermometer should be provided in the brooder and temperature kept between 32oc and 34oc.
- The brooder should be well ventilated.
- All comers should be rounded to avoid congestion of chicks in the comers.
- Water troughs and food containers should be evenly distributed around the heat source for easy accessibility.

Management of chicks in the brooder

When the chicks have been introduced, the following should be observed.

- Feeding should be adequate with enough chicks marsh.
- Plenty of water should also be supplied in the house.
- Parasites such as lice, fleas and mites should effectively be controlled with suitable insecticides all round the brooder.
- Vaccinate the birds against new castle, fowl-typhoid and gumbro disease.
- The litter should be turned
- Chicks should be dedecked to prevent cannibalism and feather plucking.
- Temperatures should be reduced from 34 to 30 to 28 birds grow older and feather up.
- When birds are beyond 6 weeks, perches can be introduced in the house for them to perch on.
- At 8 weeks, the birds are referred to as growers and can thus be transferred to the chicken house to grow to maturity.

Disease control measures in a poultry unit

- (i) **Vaccination:** - Chicks should be vaccinated when they are one day against New castle, and Gumbro disease.
- (ii) Drugs such as amporium and sulphadamadine should be mixed with feeds and water to control coccidiosis.
- (iii) All food and water containers should be well disinfected before introducing them to the poultry unit.
- (iv) Avoid un controlled access of visitors to the poultry unit.
- (v) New birds shouldn t be freely mixed with those already in the house.
- (vi) The chicken house should be well cleaned after getting rid of old birds and before introducing new ones.

- (vii) Rodents such as mice and rats should be controlled which reduce lice and mite invasion.
- (viii) Renew the litter regularly to avoid parasitic
- (ix) The chicken house should have proper and adequate ventilation.
- (x) Avoid congestion of birds in the chicken house.

CULLING

It is the removal of unproductive and sick birds from the flock during the period of production. This serves to increase the production efficiency; because there is no resource wastage on unproductive birds.

Features considered in identification of good quality birds in a laying flock

1. The comb and wattles are large, moist and brightly colour unlike those of a poor layer which are shriveled and dry.
2. The eyes are bright and lively while those for a poor layer are dull and yellowish.
3. The cloaca of a good layer is large and moist while that of a poor layer is small and dry.
4. The abdomen of a good layer is enlarged and soft while that of a poor layer is small and hard.
5. The skin is soft and loose while that of a poor layer is hard and dry.
6. A good layer has got glossy and well arranged feathers while a poor layer has got soiled, brocket and rough feathers.
7. Pigment on beaks, sharks and legs usually disappear early while that for poor layers stays for long.
8. For good layers, the distance between pelvic bones is wide above 5cm while that for a poor layer, its about 2.5cm.
9. A good layer is always dull and resting while a poor layer is always dull and resting.
10. A good layer has good appetite for feeding and drinking while a poor layer is always dull and without appetite.

Good quality egg production on the farm

For good quality egg production, the following should be ensured.

- (i) Adequate laying nests should be provided.
- (ii) All laying nests should be kept clean and disinfected.
- (iii) Eggs should be collected regularly i.e. about 3 times a day using egg trays.
- (iv) All dirty eggs should be wiped with clean damp cloth; water washing leads to moisture absorption.
- (v) Eggs should be candled to detect meat spots, blood spots etc. such eggs are eliminated.
- (vi) All birds should be debeaked to avoid egg eating in the chicken house.

- (vii) Birds should be well fed on special diet (layer's mash) and given a lot of greens and water.
- (viii) Culling in the flock should be done monthly.
- (ix) Sufficient disease control should be ensured.

VICES IN POULTRY

Vices are bad habits that develop in birds or animals kept in a confinement.

Causes of vices in poultry

- Idleness and boredom amongst birds in the flock.
- Lack of sufficient food and water for the birds.
- Lack of enough space in the house.
- Lack of some nutrients in the diet.
- High temperatures in the house, at times due to poor ventilation.
- Lack of laying nests among layers.

Types of vices in poultry

1. **Cannibalism:** - It involves birds killing and eating each other in the flock.
2. **Egg eating:** - Birds tend to eat eggs after laying them.
3. **Toe pecking:** - Birds peck on the toes of one another.
4. **Feather plucking:** - Birds pluck feathers of one another.

Control of vices in poultry houses.

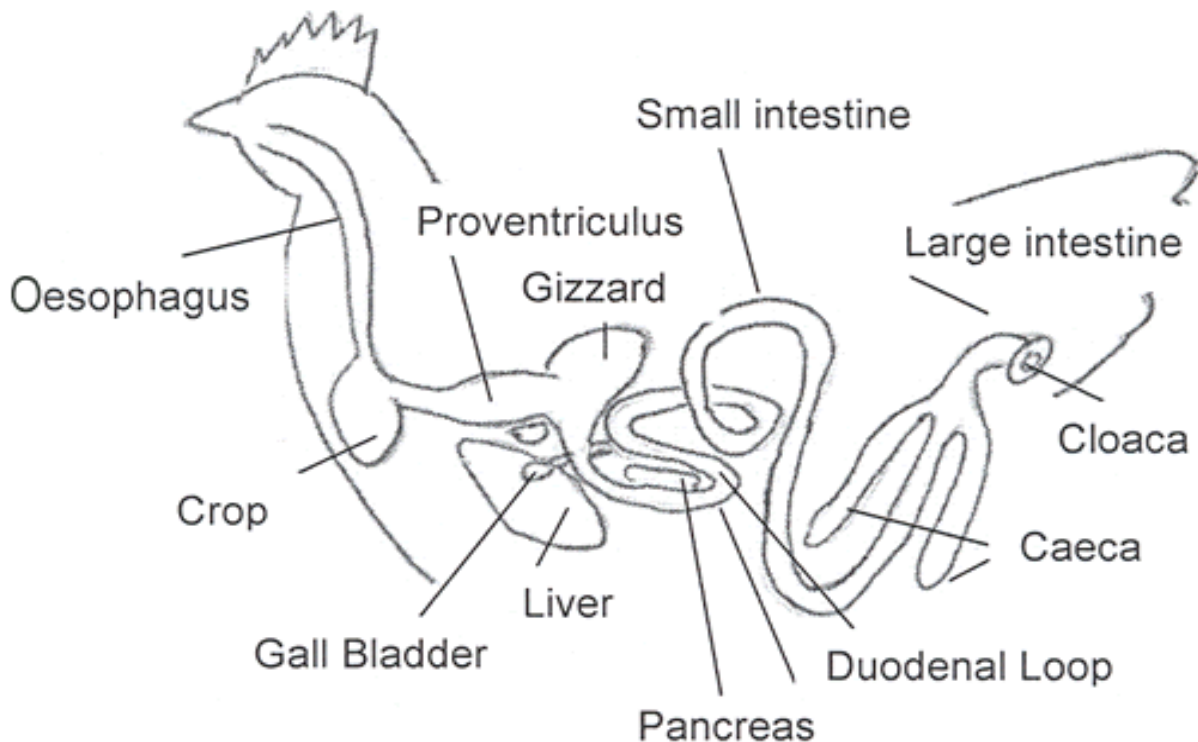
- (i) Avoid keeping birds of different age groups in the same deep litter house.
- (ii) Isolate sick, weak birds as soon as they are identified before they can fall victims.
- (iii) Sufficient space should be provided per birds.
- (iv) Birds should always be debeaked.
- (v) A balanced food ration should be given to the birds.
- (vi) Eggs should be regularly collected i.e. 2 or 3 times a day to avoid being eaten.
- (vii) Provide plenty of greens and scatter a lot of grain in the house.
- (viii) The litter in the house should be thick enough and dry to keep the birds scratching.
- (ix) Avoid too much light in the chicken house.

FEEDING AND DIGESTION IN POULTRY

Essential ingredients in a poultry diet

- (i) **Crushed shells and bones:** - These provide calcium and phosphorous.
- (ii) **Crushed fish:** - Provides proteins.
- (iii) **Grinded grass:** - Provides carbohydrates.
- (iv) **Greens:** - Provides vitamin A and proteins.
- (v) **Agricultural lime:-** Provides calcium.
- (vi) **Grit:** - These are tiny stone particles for crushing food in the gizzard during digestion.

Structure and parts of the digestive system



Functions of the parts

- (i) **The beak:** - It picks and partly breaks down the food and adds saliva before swallowing.
- (ii) **Esophagus:** - It peristaltically delivers food to the crop.
- (iii) **The crop:** - It temporarily stores the food. It also moistens the food before it is sent to the proventriculus.
- (iv) **Proventriculus (glandular stomach):-** It is where digestion of proteins takes place. It occurs with the help of pepsin (together with HCl) secreted by the stomach walls.
- (v) **The gizzard:** - It has thick muscular walls. It contains grit. Grit helps to grind coarse food particles to simpler ones for easy digestion.
- (vi) **Small intestines:** - Here, enzymes that break down carbohydrates, proteins and fats into simpler compounds are secreted by the pancreas.
- (vii) **The ceaca (caecum singular):-** They are two lobes. They contain bacteria that help in break down to fibre. They also provide a surface for water absorption.
- (viii) **Large intestine:** - It is short in length. It is where excess moisture is absorbed.
- (ix) **Rectum:** - It stores waste products (faeces) before sending them out through the cloaca.
- (x) **Cloaca:** - It is an exit for faeces, urine (and eggs).

PIG MANAGEMENT.

Piggery is the keeping of pigs. The aim is to produce and rear pigs for pork, bacon and lard.

IMPORTANCE OF REARING PIGS.

- Produce large litters between 8-12 piglets at once within the gestation period.
- Require a small area to raise and yield highly than cattle that is back yard farming.
- Financial returns within a short period as piglets can reach slaughtering weight within a short time after weaning.
- Short gestation period of about 110-120 days so three litters can be got in a year.
- They are efficient converters of feeds into pork when managed well.
- Omnivorous and can feed on anything like residues of alcohol, left over from the kitchen and contents from slaughter houses.
- Low initial cost to establish a pig farm as the capital involved is lower than in other enterprises.

- Provide excellent manure, which is used to improve the productivity of the soil.
- Most of the parts are used when a pig is slaughtered for example hair is used to make brushes, hooves for glue, bones for bone meal, entrails and blood for sausages.[High killing percentage]
- Have a shorter maturity period as they reach slaughtering age faster than cattle.

Problems of rearing.

Farmers engaged in piggery are faced with the following challenges.

- Compete with man for food since pigs cannot handle roughages, they are fed on cereal grains which is staple food in many areas.
- Pork is not accepted internationally as food by some cultures and religious groups.
- Pollute the environment as the bad smell from pig sties necessitates sitting pig houses far away from living quarters.
- Destroy crops especially root crops if left to scavenge for themselves.
- Spread parasites to man especially jiggers.
- Highly susceptible to diseases such as swine fever which can wipe out farms.
- Internal worms such as round worms and external parasites such as lice have an effect on production.
- Heat stroke can easily kill pigs especially strong heat.
- Poor market ability of the pig products as there are no marketing bodies directly concerned with pig products.

Solutions to the pig industry

- Regular worming to control internal parasites.
- Constructing sties and roofed with materials which do not allow in strong heat.
- Regular vaccination to prevent infectious diseases such as swine fever.
- Regular spraying to control external parasites or smearing old engine oil on the body.
- Making concrete floors which are easy to reduce bad smell.
- Having organized markets for buying and selling pork.
- Confining animals in a well constructed sty to overcome food crop damage.

Pig breeds.

Common pig breeds are Landrace, Hampshire, Yorkshire, Duroc-Jersey, Saddle back, Tamworth, Berkshire and Chester.

Rearing systems

These include the following;

- Scavenging systems; pigs are let loose and fend for themselves day and night. Commonly used by local farmers keeping local breeds which are more tolerant to poor quality feeds, resist and to more tolerant to poor quality feeds, resists and to parasites and strong heat. The system is out dated due to increase in population, and land shortage.

- **Background / Tethering;**

Pigs are kept in simple structures behind most homesteads or others tether them with a rope around the neck or on the leg.

Productivity in this system is relatively low in terms of litter and pork because of poor feeding management. Usually fed on kitchen left over and supplemented with rice, maize, wheat bran and residues of alcohol.

- **Modern / large scale production ;**

Pigs are housed in well constructed sites or house where proper management is provided.

-The house has a concrete floor for ease of cleaning.

-Feed and water troughs are provided within. They are cemented for ease of cleaning.

A creep area is provided for those with piglets.

-Water is provided adlib.

-Properly mixed feeds [sow and weaner meal] is provided in adequate amount.

-Disease and pest control carried out regularly

-Breeding is controlled by selecting good breeds to be parents of future generation.

-Stocking rate is usually higher.

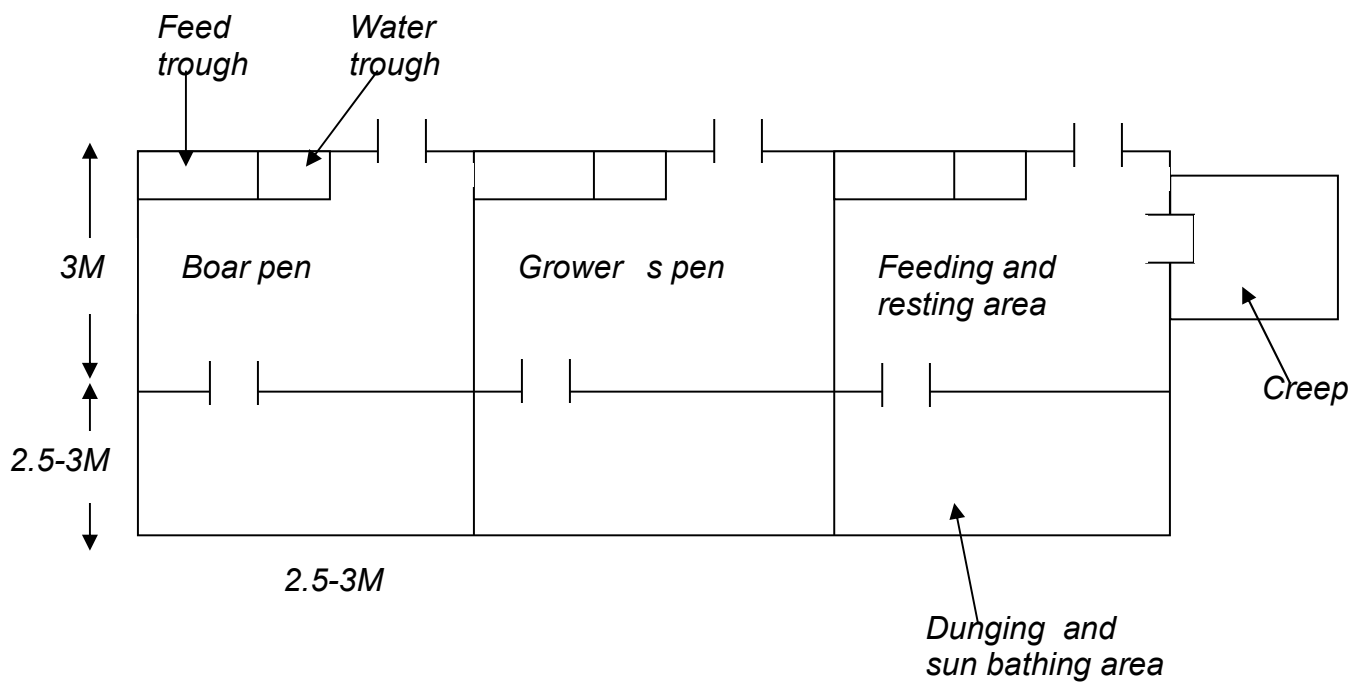
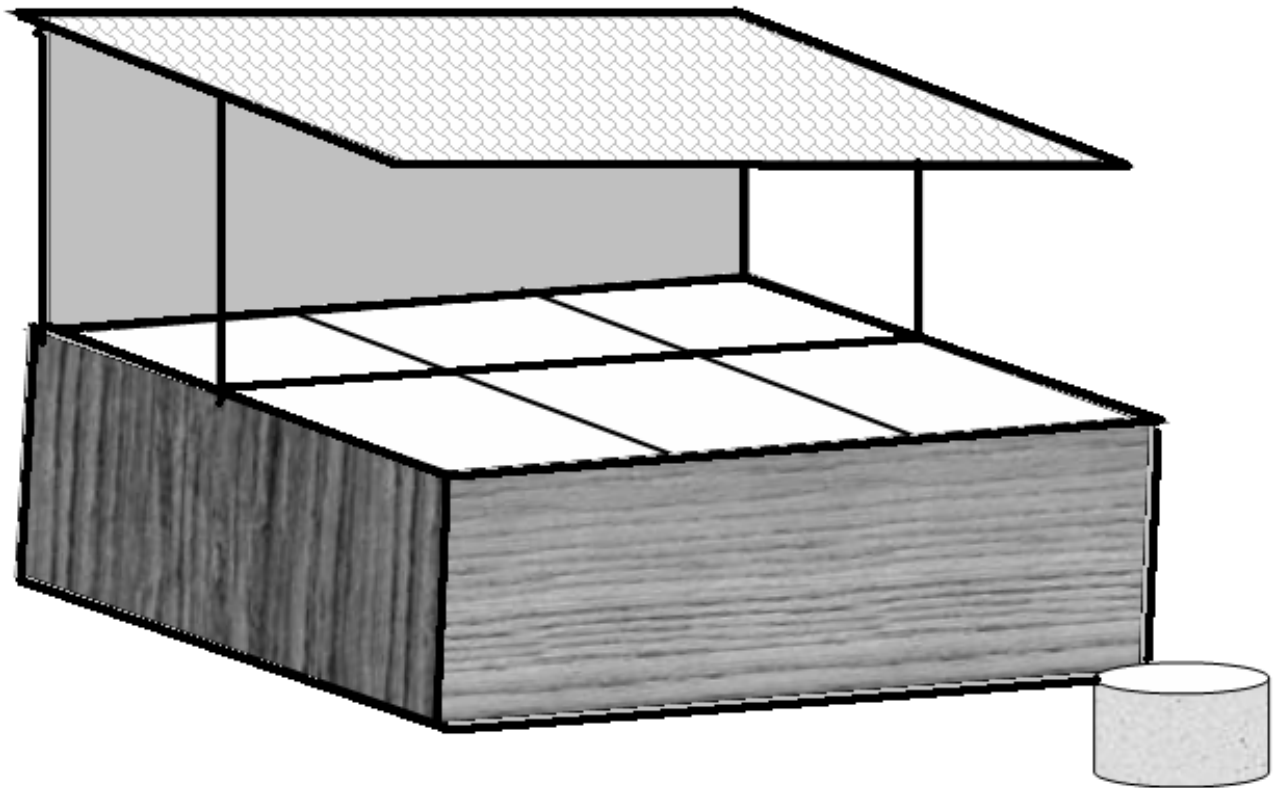
-Castration, ear tagging or ear notching is carried out.

-Stocking rate is usually higher.

-In this system, each pig is in its own unit apart from piglets which stay together in one unit. However as they grow, they are separated according to sex and put in different units.

HOUSING

Pigs are housed in sties.



Housing pigs has the following advantages.

- 1 Improved feed efficiency as pigs have no choice.
- 2 Efficient diseases and pest control, as they do not mix stray pigs.
- 3 Easy to collect droppings from the unit to preserve them into manure.
- 4 Pigs are protected from harsh weather conditions.
5. Lower production costs in terms of labour and time saved on feeding and watering.

Features of a good sty.

- Well ventilated to allow free air circulation.
- Good drainage to allow easy flow of urine and water.
- Slanting rough floor to prevent skidding and ease cleaning.
- Rain proof covered with grass to reduce heat.
- Strong built walls.
- Adequate space.
- Feed and water troughs.

Pig houses can take any of the following forms.

- 1 Elevated pig sty.
- 2 Poles are fixed in the ground firmly.
- 3 A wooden floor is made a reasonable height above the ground. This does not allow the animals to come into contact with soil. As a result, susceptibility to parasite infection reduced.

Management of gilt.

Gilt are female pigs that have not gone on heat. They attain sexual maturity at the age of 5-6 months. However, they should be served when they are 8-9 months. (Flushing has been discussed in detail in chapter 1).

When they are on heat should be served on the second day of heat or 12-24 hours after the onset of heat. It is common to allow the boar stay with the gilt during this period. This permits continuous mounting. The mating lasts for about 25 minutes. The boar/ gilt should not be interrupted during this period.

It is advisable to keep breeding records. This enables the farmer to know whether the gilt conceived, determine following date and steaming up period.

Gestation period is between 110-115 days (3 months, 3 weeks, 3 days).

Management of a pregnant sow/ gilt.

Pigs are fed on sow and weaner meal on a daily basis. The amount per day is about 2.5- 3.5 kg. The ratio provided should meet the growth, maintenance requirements and cater for foetal growth in addition to milk production in case of one which has farrowed.

Plenty of clean water should be provided all the time.

Provide minerals and vitamins in the correct amount. Inadequate supply of vitamin A and E result into death of embryos. Vitamin B complex deficiency leads to low production of antibodies hence low immunity at birth.

De worm the sow about 2 weeks before farrowing. Spray regularly to control external parasites such as lice and mites. Steam up the sow/ gilt 1 ½ months to farrowing. Give 3-4 kg concentrates per day. Care should be taken not to over feed concentrates as may lead to; fatness and difficulty in farrowing, overstocking of the mammary glands resulting into mastitis.

Signs of farrowing

These include;

- Restless
- Fore milk (colostrum) is seen on the teats/ milk dripping from the teats.
- Swollen, enlarged, flabby vulva.
- Continuous heavy breathing
- Low lying down
- Watery discharge seen at the vulva.
- Pelvic muscles slacken.
- Loss of appetite.
- Sow prepares a nest from dry beddings.

Care during farrowing.

Allow the sow/ gilt farrow without disturbance. Keep watching at close distance. Assist where possible to avoid crushing of piglets by the mother or being eaten by the mother, remove the foetal mucus from the snout, disinfecting of the umbilical cord and removal of the after birth. Provide warm water or warm bran to avoid constipation and ease cleansing. Seek veterinary help in case the afterbirth is retained. Reduce the amount of ration given after farrowing to prevent stomach upsets. Plenty of clean water should be provided adlib.

Care of piglets

The following management practices should be carried out for survival of piglets. Special care is vital in the first week.

- Remove the foetal mucus from the snout.
- Disinfect the umbilical cord with iodine.
- Inject piglets with iron to prevent piglet anaemia.
- Needle teeth should be removed to prevent damage of sow's teats.
- Provide warmth to prevent chilling of piglets as they are born naked. The temperature should be 32°C. This can be achieved by keeping piglets in a warm room.
- Weigh piglets to determine birth weight. Regular weighing should be done to know body weight gain from feeding programmes
- Provide creep feed which is rich in proteins after 1 week of feeding on milk.

- Creep feed should be put in the creep area. A guard rail is put 20-30 cm from walls of resting area to avoid crushing of piglets by the sow. Creep feeding facilitates early weaning.
- . Castrate piglets when they are 2-3 weeks of age before weaning them. Common method used is surgical. Carry out identification by ear notching or ear tagging. Ear notching is the commonest method of identifying pigs.
- Provide plenty of clean water adlib.
- Provide sows with 2.5 kg sow and weaner ration and an extra 0.25kg feed per piglet. Therefore a sow with 10 piglets will be given $2.5\text{kg} + (10 \times 0.25) \text{kg}$. This means $2.5 + 2.5\text{kg} = 5\text{kg}$ ratio per day. This ensures that the sow is able to meet the demands of the piglets.
- De worm piglets at weaning time and at an interval of 1 1/2 months.
- Control external parasites by spraying or smearing old engine oil on their bodies.
- Follow a regular vaccination programme against hog cholera and other diseases.
- Ensure general hygiene in the pen.
- Reduce the amount of ratio given to the sow few days before weaning. This has an influence on milk production.
- Towards weaning, taken the sow and piglets to the growing pen.
- Weaning should be done when piglets are 3-4 weeks old. Separate the sow from the litter on the of weaning. Do not mix litter from different sows to avoid fighting and vices.

It s worth noting that when piglets are weaned early, the following benefits are achieved.

- The sows goes on heat immediately and can be mounted (rebreeding).
- Excessive loss of weight by the sow is avoided.
- Provides proper feeding for the sow.
- Runts are fewer.
- The sow gains weight quickly and can be sold.
- Diseases transmission from the sow to piglets is minimized.

However to achieve, this, the farmer has to incur extra costs in feeding, have higher level of management to overcome mortality and employ more people to look after the farm.

Management of the boar.

- A boar is a male pig. Boars reach puberty at the age of 8 months. Care should be taken not to allow it mount frequently at this age.

- Boars are fed in the same way as sows. However they should not be over fed as they will become heavy. This affects their mounting ability.
- Provide plenty of good pasture and supplement it with concentrates.
- Provide plenty of clean water adlib. Deworming should be carried out on a regular basis.
- Ensure high hygiene in the pen to avoid disease outbreak.
- Control external parasites as they affect productivity.

Diseases and parasites.

Common diseases and parasites affecting pigs have been discussed in detail in chapter 2. However a diseased pig will show any of the following;

- Watery faeces with a foul smell.
- Loss of appetite.
- Dry, pale, standing hair coat.
- Coughing.
- High or low body temperature.
- Watery eyes.
- Discharges from the nose.
- Dullness and the pig lies down all the time.
- Groaning, grunting and grinding its teeth.

FEEDING AND NUTRITION IN LIVESTOCK DIGESTION

It is defined as the break down of complex food to simpler substances that can be absorbed into the blood stream through the walls of the gut.

Types of digestive system

- i. Ruminants digestive system.
- ii. Non-ruminants digestive system.

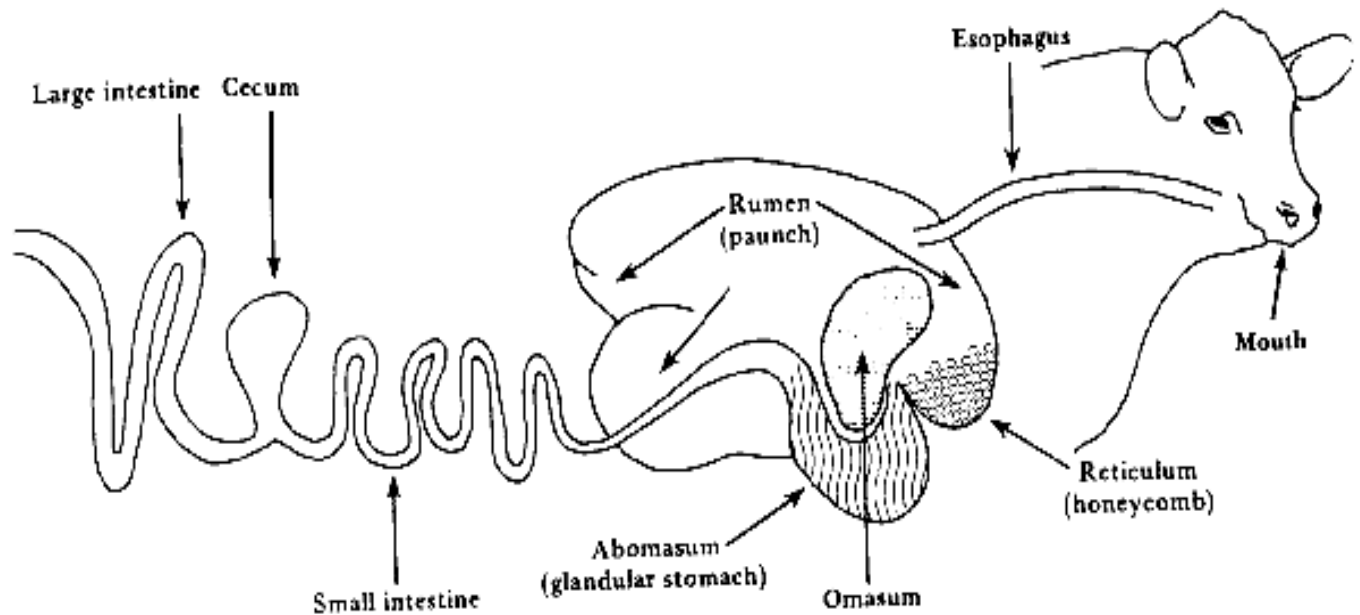
RUMINANTS

These are animals that swallow their food, partly digest it, then return to the mouth to chew it further (i.e. animals that chew cud).

Ruminants include cattle, sheep, goats, buffaloes etc.

They have got four stomach chambers in their system

Basic structure of the digestive system of a ruminant



The process of digestion

- (a) **The mouth:** - here food is chewed by teeth and mixed with saliva. Saliva moistens the food for easy passage down the gullet. Unlike non-ruminants, ruminants' saliva does not contain salivary amylase or ptyalin.
- (b) **Esophagus (gullet):**- it facilitates peristaltic movement of food from the mouth to the rumen and even
- (c) It is the first and largest of the four chambers

Its functions are;

- (i) It stores food temporarily before it is returned to the mouth for rumination.
- (ii) It is where food is softened and fermented by micro-organisms that include protozoa, fungi and these break down cellulose into useful products organic acids.
- (iii) The micro-organisms in the rumen also manufacture amino acid from Non-protein Nitrogen compound like urea.
- (iv) Vitamins such as B1, B12 and even C are synthesized by the microbes in the rumen.

(d) **Reticulum (Honey comb):**- It has the texture of honey combs. It is the next compartment after the functions are;

- (i) it separates coarse food materials from the finer ones.

- (ii) It retains foreign materials such as stones, wood before the food is passed on to the omasum.

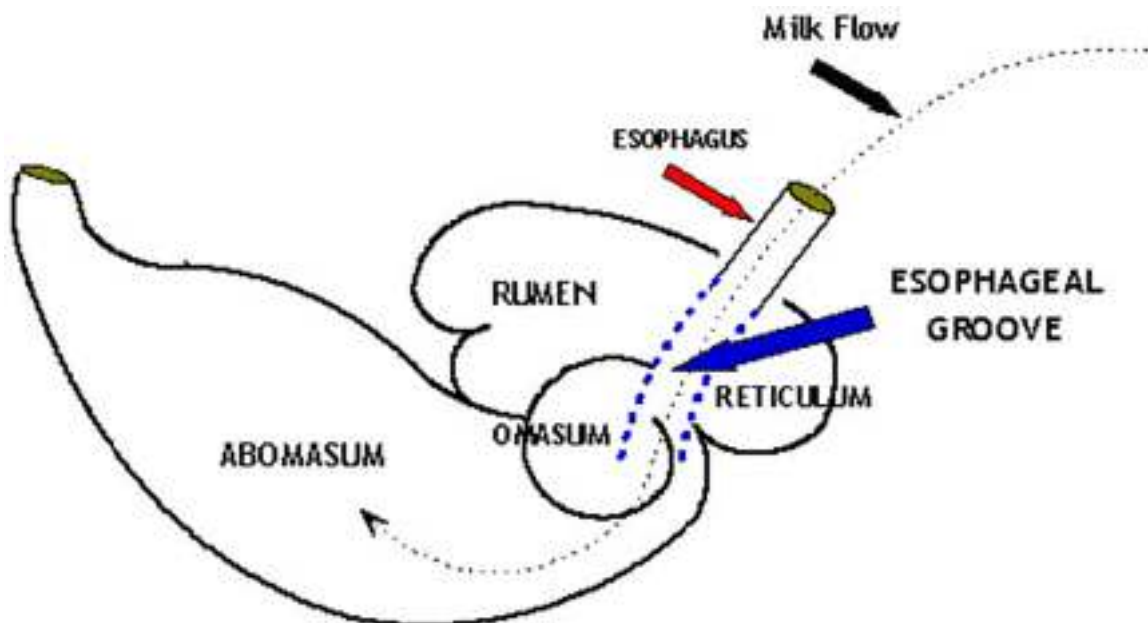
(e) Omasum: - It is the next compartment following the reticulum. It has many parallel rough surfaced leaves which;

- Grind the food to fine consistency.
- Absorb water (moisture) from food before it goes to the abomasums.

(f) Abomasums (true stomach):- It is the 4th compartment. It is where enzymatic (chemical digestion) starts walls secrete gastric juice that contains enzymes pepsin and rennin.

- Pepsin breaks down proteins to polypeptides.
- Rennin coagulates (curdles) milk protein (casein) and its broken down.
- The walls also secrete HCl that;
 - Provides a conducive environment for action of pepsin and rennin.
 - Kills harmful bacteria that can be found in this compartment.
 - After the abomasums, the sequence of events is essentially the same as in non-ruminants.

The digestive system of the calf

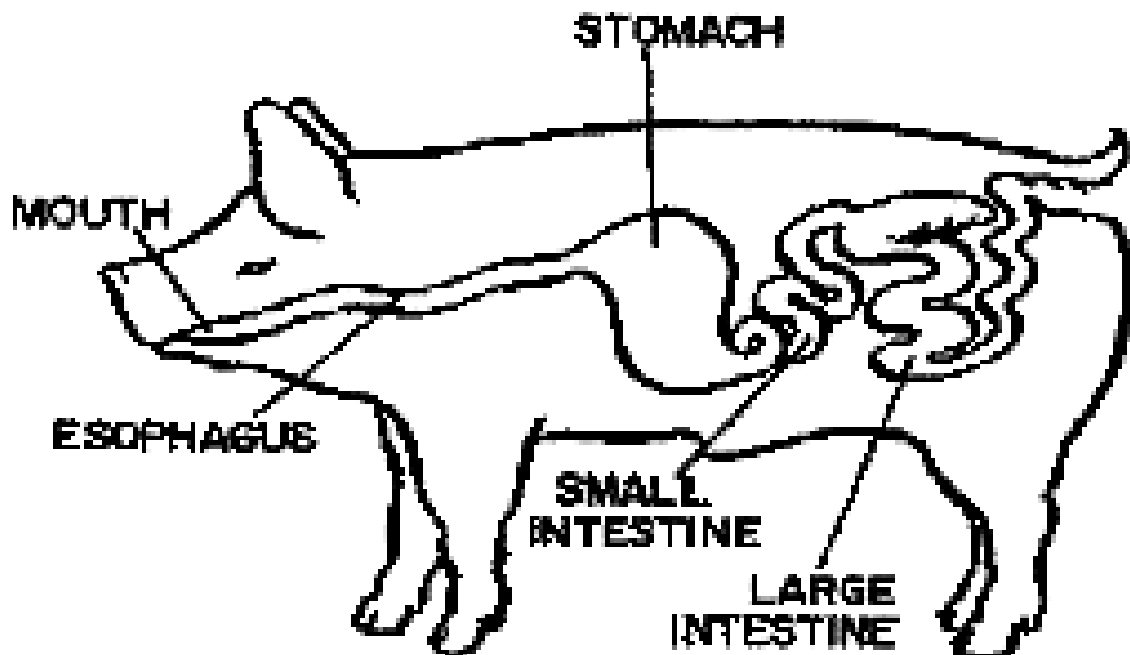


The rumen in the young calf is not yet developed and the calf only has a fully functioning abomasums. Digestion is therefore similar to that of any single stomached animal.

Liquid food (milk) is directly conveyed to the abomasums through a channel called the esophageal groove. The groove serves to prevent movement of food into the undeveloped compartments of the rumen, reticulum and omasum.

By the 12th week of growth, the rumen is fully developed with its micro-organisms established. The calf can therefore start utilizing fibrous food than milk alone at this age.

NON RUMINANTS



Process of digestion

- (i) **Mouth:** - Food is chewed and mixed with saliva. Saliva contains salivary amylase (ptyalin) that breaks down starch to maltose.
- (ii) **Oesophagus:-** Its where food is peristaltically delivered to the stomach.
- (iii) **Stomach:-** Its where food is first stored before break down by pepsin and rennin. Pepsin breaks down proteins to polypeptides while rennin coagulates casein. The walls also secrete HCl which provides a conducive PH for action of pepsin and rennin and also kills harmful bacteria in the gut.
- (iv) **Duodenum:** - In this region, the pancreas secretes pancreatic juice, which contains 3 enzymes, namely amylase, lipase and trypsin.
 - Amylase breaks down starch to maltose.
 - Lipase breaks down lipids (fats and oils) to fatty acids and glycerol.
 - Trypsin breaks down polypeptides to peptides.The liver also secretes bile which contains bile, salts, whose functions are;
 - Neutralize acidity in the gut.
 - Emulsify lipids so that they can be easily broken down.
- (v) **Small intestines:** - The walls secrete intestinal juice containing 4 enzymes namely, peptidase, maltase, sucrase, and lactase.
 - Peptidase converts peptides to amino acids.
 - Maltase converts maltose to glucose.
 - Sucrase changes sucrose to glucose and fructose.
 - Lactase converts lactose to glucose and galactose.It is in small intestines that digestion is completed. Absorption of all these substances takes place
- (vi) **Large intestines (colon):-** It absorbs water from the food in the gut.
- (vii) **Caecum:** - It is a lobe where some bacterial digestion takes place.
- (viii) **Rectum:** - No absorption takes place here. It only assists in getting rid of the dung from the body.
- (ix) **Anus:** - It is the exit for dung from the body.

Difference between ruminants and non ruminants

Ruminants	Non ruminants
- Have 4 stomach chambers. (polygastric)	- Have one stomach chamber (monogastric)
- Have no salivary amylase (ptyalin) in the saliva	- Have ptyalin in the saliva
- Can easily digest cellulose (fibre)	- Cannot digest cellulose
- Have microbes to synthesise proteins and vitamins	- Do not have these microbes
- Some water is absorbed in the omasum	- All water is absorbed in the large intestines.

Similarities

- (i) Both ruminants and non ruminants have a single stomach when they are still young.
- (ii) In both, final digestion of proteins and carbohydrates takes place in small intestines.
- (iii) In both, enzymes are similar from the true stomach to small intestines.
- (iv) In both, water absorption takes places in large intestines.

Appropriate livestock handling Techniques while feeding:

Farmers handle animals in a number of ways while feeding them. These vary with the type of animal and its purpose.

- Adliitum (adlib): adlitum feeding, animals are provided with unlimited amount of feeds. They feed according to appetite. This is common with beef cattle, lactating animals pigs, and poultry. Animals feed throughout the day.
- Fixed amount. This is a method of feeding where animals given fixed amount of feed at fixed times. it is sometimes away of controlling excessive weight gain at other times the farmer is trying to economize a particular type of feeds which is scarce and others are abundant. Pigs that have reached market weight have restricted feeding if they are meant to provide pork.
- Challenge feeding; this is used on lactating cows. A cow is provided with more concentrates until such a point when its milk yield does not increase. Thereafter that cow should not be given more or less of the concentrates.
- Force feeding: it is an emergency method used to feed young animals that have failed to eat young turkeys may fail to eat in their first days of life therefore, need force feeding .it can also be used on other animals to increase their chances.

FEEDING AND FEED STUFFS

In order to feed livestock well, the farmer needs to know

- (i) What does food contain?

- (ii) What does the animal require?

Functions of food in livestock

- (i) To supply energy in form of heat.
- (ii) To supply nutrients for repair of worn out tissue
- (iii) For body growth.
- (iv) For maintenance of pregnancy
- (v) For production of items like milk, beef, eggs etc.

Constituents of food

The major food constituents required by livestock are;

- (i) Carbohydrates
- (ii) Water
- (iii) Proteins
- (iv) Vitamins
- (v) Mineral salts
- (vi) Fats and oils
- (vii) Fibre (roughages)

1. Water

Importance

- (i) It constitutes 60% of the body tissue. 40% is dry.
- (ii) It acts a solvent for many bio-chemical process the body
- (iii) It helps in body temperature regulation.
- (iv) Ti gives the body its shape.

Animals can obtain water through drinking or if it is in food e.g. succulent foods or concentrates.

Factors governing water intake by farm animals.

- Size of animal: Friesians tend to drink more water than Zebu.
- Dry matter content: dry rations make animals drink more water than succulent feeds e.g. hay and Mash.
- Accessibility: when supplied all the time, the intake is high. all the time
- Productivity: Dry cows need less water than high yielding animals.
- Environmental temperature: during hot seasons animals take more water than during cold seasons.
- Salinity of water: saline encourages more in take.
- Physiological state; During pregnancy and lactation , more water is taken in by the animals
- Physical exercise: Oxen need more water than cows kept in a zero grazing unit.

Water can be lost from the body through the following processes:

- Urinating.
- Sweating.

- Defecating as animals pass out semi solid faeces
- Expiration
- Milking/lactating cows.

2. Carbohydrates

The main components are sugars and starches which make up the biggest part of food eaten by the animals. Carbohydrates are categorized as monosaccharide (glucose and, fructose) and disaccharides (sucrose, maltose and lactose) and polysaccharides (cellulose and lignin)

These food stuffs therefore, contain carbon, hydrogen and oxygen.

Their main function is to provide energy in body. The major source of carbohydrate is plant material.

Roles played by carbohydrates in animal nutrition are:

- Yield energy needed for various metabolic activities when oxidized.
- Excess is oxidized and stored as fats.
- Carbohydrates in form roughages prevent constipation
- Body structure have carbohydrates in them
- Have a sparing effect on proteins as a source of energy.

3. Protein.

The building blocks are amino acids. These make up long chains. Animals obtain amino acids from the food they eat as their bodies cannot build them from carbohydrates sulphates and nitrates.

Therefore proteins are looked at as complex compounds that contain hydrogen and oxygen. Some times they also contain magnesium etc. they are made of small units called acids.

Importance of proteins.

- (i) They are constitutes of hair, hooves and of live stocks
- (ii) They act as enzymes and prosthietic groups.
- (iii) They are major components of the animal body
- (iv) And transportation of mineral salts in the body.
- (v) They help to regulate body p4

Sources of protein include.

- Plant materials especially legumes.
- High proteins concentrate such as fish meal etc.

4. Minerals.

These are specific elements required by the animals for proper body functioning. Examples include calcium, phosphorus, iron, manganese, cobalt, iodine etc.

- (i) **Calcium and phosphorus:-** They are both needed for bone and teeth development in animals, while in poultry they are also needed for development of egg shells.

Deficiency leads to;

- Thin or soft shelled eggs in a laying flock
 - Softening of bones especially in cattle (osteoporosis)
 - Milk fever, a condition of general paralysis, coma or even death in newly lactating animals.
- Source Ca and p include salt links, mineral links shells etc.

- (ii) **Iodine (I):-** Required for syntheses of thyroxine. Deficiency leads to goiter in man livestock. It can be obtained from grasses, salt and mineral licks.

- (iii) **Iron:-** It is required for formation of hemoglobin, an important component of blood. Deficiency may lead to anemia (Pig le anaemia in piglets)

- (iv) **Sulphur:-** It is an important component of a. a and thus proteins especially the fibrous. Deficiency leads to poor wool production in sheep.

5. **Vitamins.**

These are organic chemical substances needed in small quantities to promote and maintain health in animals. They are obtained in the forage animals eat such as legumes, cereals fodder, meat and fish meals. They are grouped into Water soluble vitamins such as Vitamin B-complex and vitamin C and Fat soluble vitamins such as A, D, E and K.

These are complex compounds required in the body for a number of processes.

General functions

- (i) They promote growth of the body
- (ii) They are important in bone formation
- (iii) They enhance immunity in animals
- (iv) They assist in blood clotting
- (v) They help in muscular activity.

Types of vitamins

- (i) **Vitamin A (Retinol):-** It s for body immunity improvement of vision.
- (ii) **Vitamin B, B1, B2 and B12:-** They promote metabolic activities. Most of these are manufactured in the rumen by the microbes.

(iii) Vitamin C (Ascorbic acid):- Rein force immunity. It is manufactured by microbes in the rumen.

(iv) Vitamin D (Calseferol):- For absorption of Ca and P. It is synthesized by the body in sunlight.

(v) Vitamin E (Tocopherol):- For fertility and muscular activities. It is common in greens and grains.

(vi) Vitamin K:- For blood clotting. It is commonly found in green leaves.

Common deficiencies associated with Vitamins are.

- Rickets (soft and deformed bones) - Vitamin D.
- Night blindness-vitamin A.
- Sterility vitamin E
- Scurvy- Vitamin C.

Fats and oils:

Fats and oils yield more Carbon, hydrogen and oxygen. Fats originate from animal products such as fish meal. Oils are mainly from plants such as cotton seedcake, groundnuts cake, soyabean cake, etc. Fats are solid at room temperatures while oils are liquids at room temperature.

Functions

- They yield more energy than carbohydrates when oxidized.
- Fat deposits below the skin insulate the body against heat loss.

Classification of feed stuffs

These are classified according to water content and characteristics.

1. Concentrates

These are commercially prepared feeds rich in proteins and energy. They can be made from grains and grain by products such as maize bran. They can also be made from a mixture of blood and bones. Other sources of ingredients are the oil extracting factories where cotton and groundnut seed residues are obtained. Sugar refineries are also a source of molasses which too, are used as ingredients.

They have the following characteristics

- They contain high protein or carbohydrate to which a mineral is added.
- They have low moisture content (less than 20%)
- They are soluble and can easily be digested.
- They have got a low fibre content.

They are grouped as;

(a) High protein concentration:- These contain over 50% protein. They can be;

- 1st class protein:-** e.g. fish meal, meat meal, blood meal etc.
- 2nd class protein:-** cotton seed cake, Groundnut seed cake or S.B.S.C.

(b) High energy concentrates:- These largely contain carbohydrates e.g. maize, sorghum, millet, rice and other cereals but with small quantities of protein and fats.

(c) Balanced concentrates:- They contain similar proportions of carbohydrates, some vitamins, oils etc. examples include dairy meal, layers mash etc.

2. Succulent feeds

They have the following characteristics.

- They have high moisture content (over 80%).
 - They have low dry matter content.
 - They are highly digestible.
 - They have high vitamin content.
- Examples include young grass, silage, cabbage, cassava and potato peelings or matooke peelings.

3. Roughages

These are bulky feeds of plant origin. They however have a low food value contents. Roughages are categorized into two that is succulent and dry roughages. Succulent roughages contain a good amount of moisture such as green pastures, Guatemala, potato vines, peelings of banana and sweet potatoes, silage. Dry roughages have a low moisture content, high fibrocontent, low digestibility and nutritive value. Examples are: hay, stovers and their palatability is improved by addition of molasses.

Characteristics

- They are coarse and highly fibrous feeds of plant origin.
 - They have low moisture content.
 - They are indigestible and have a low nutrient content.
 - They serve to enhance functioning of digestive system (prevent constipation).
- Examples include hay, silage, straw and dry legumes.

Feed additives

Substances given to animals in form of growth hormones, antibiotics, wormicides and flavorings called feed additives. The aim is to improve on feed intake and performance of the animal. Examples are;

- Growth hormones thyroxine
- Antibiotics added to feeds and water to protect animals against disease outbreaks e.g. penicillin.
- Wormicides control internal parasites such as tapeworms.
- Mineral licks provide minerals to the animals
- Flavorings improve palatability and feed intake.

Vitamin supplements:

Vitamins are contained in most ingredients used when mixing mineral feeds. For this reason, small quantity is added to animal feeds during ration formulation. A small quantity of Pre-mix vitamin is usually added overcome vitamin deficiency.

RATIONS

A ration is a mixture of feeds made for livestock to meet their nutritional demands.

Maintenance ration

It is the quantity of food required to keep animals alive without losing or gaining weight and without producing anything like milk, eggs etc. its only essential for animal health and survival.

Production ration

It is the food required by the animal; in addition to maintenance ration to enable animal become economically productive.

Importance of production ration

- For production of wool, milk or eggs.
- For fattening of mature animals before slaughter.
- For maintenance of pregnancy.
- For provision of energy e.g. for cultivation, cart pulling etc.

FORMULATION OF FOOD RATIONS

Factors considered when formulating food rations

- (i) Nutrient requirement for the animal according to deficiency or purpose of the animal.
- (ii) Digestibility of the feed.
- (iii) Species of the animal to be fed e.g. ox, sheep, pig etc.
- (iv) Age of the animal e.g. young ones feed differently from old ones.
- (v) Palatability of the feed to the animals fed.
- (vi) Availability of ingredients
- (vii) Purpose of the feed e.g. sole feed or supplements.

Terms used to express feed values

- (i) **Crude fibre (C.F):-** It is the total amount of fibre contained in a feed. Its majorly lignin and cellulose.
- (ii) **Dry matter (D.M):-** It is the material left in the feed after extraction of water.
- (iii) **Crude protein (C.P):-** It is the total amount of protein in a feed. It includes mixture of true protein, peptides, ammonia salts etc.
- (iv) **Digestible crude protein (D.C.P):-** It is the proportion of crude proteins which an animal is capable of digesting.
- (v) **Total digestible nutrient (T.D.N):-** It is the sum of all digestible organic nutrients such as fats, proteins, carbohydrates and fibre.
- (vi) **Starch equivalent (S.E):-** It is the amount of pure starch that has got the same energy as 100kg of the feed.
- (vii) **Metabolisable Energy (ME);** Proportion of energy in animal metabolism. It can be viewed as digestible energy left after all the energy lost in removal of waste products is subtracted.
- (viii) **Digestible energy;** Energy in food minus energy lost in faeces
- (ix) **Dry matter (DM):** Food material minus all the water or component of food left after drying.
- (x) **Maintenance ration(MR) :** amount of food needed to keep the animal healthy and in good condition
- (xi) **Production ration:** Amount of food needed to make a farm animal produce products such as eggs, milk and meat.
- (xii) **Growth ration:** Food given to growing animal.
- (xiii) **Digestibility:** Proportion of food which is digested and is of value to the animal after absorption.

Methods used in ration formation

- (a) use of T.D.N and D.C.P
- (b) graphical methods
- (c) Use of Pearson's square
- (d) Solving simultaneous equations

Factors affecting utilization of rations by animals.

There are several factors and these include:

- The age of the animal; young animals effectively use proteins for growth, minerals for bone formation compared to mature animals.
- Health status: Healthy animals utilize rations better than diseased animals.
- Digestibility; Feeds with low digestibility are less utilized than feeds which are highly digestible.
- Physiological state of the animal; Dry animals do not effectively use rations as compared to pregnant animals, lactating and fattening animals.

- Type animals; non ruminants utilize concentrates while ruminant animals are good converters of coarse rations such as roughages.
- Processing: Reduces the bulk and eases digestibility. Mash is highly utilized than whole maize grains.
- Amount of food given per day .Excess feeds are poorly utilized, while adequate feeds given are the utilized.
- Additives, flavoring, antibiotics and hormones improve feed intake.
- Nutrient content ; balanced feeds have a higher digestibility and utilization than poorly balanced feeds
- Climate; favorable temperature in animal quarters improve feed intake and utilization. Too high or too low temperatures lower feed intake.

Use of Pearson's square

- Draw a square
- Place the required final protein percentage at the centre.
- Place the protein percentage (%ge) of energy feed on the top left side and protein feed on bottom left side of the square.
- Draw diagonals and subtract the smaller figure from the large, diagonally, regardless of the sign as to obtain the respective parts of each feed.

Exercise

A farmer wants to make a ration of 16% protein using maize containing 11% protein and cereal balancer containing 36% protein. Find the amount of each feed stuff required to make 120kg of the feed.

Limitation of Pearson's square

This method deals with only two types of feed. i.e protein and energy feeds, this, there is always need to supplement the ration with a source of vitamins and minerals e.g by adding some green vegetables, pastures or some salts.

ANIMAL HEALTH

Health and Diseases

When all body organs and systems are functioning normally we say the animal is in state of good health. On the other hand, disease is a condition of ill health. This is a condition when the body systems and organs do not function well. It is a deviation from the normal functioning of the body organs and systems. In other words, any interference with the body process may lead to a state of ill-health.

In case of poor healthy, production of milk, eggs, and wool, hides and wool is poor and the animal also grow poorly. Farm animals should be healthy in order to realize good production of milk, meat, wool, hides and skins. other than production of good products, farm animals should be kept healthy for the following reasons.

- Healthier animals are easier to manage as the cost of production is less.
- It is a source of encouragement to the farmer once the animals look nice and healthy.
- High production is realized and therefore, more income.
- The animals quickly grow and reach market age in a short time.
- The animal products are safe for human consumption
- Animals have long fecundity and longevity (production cycles)
- Animal products are of good quality and therefore, fetch high market prices.

Causes of ill-health in livestock

- (i) **Pathogens:** - Like bacteria, fungi, protozoa or virus.
- (ii) **Parasites:** - Such as worms, flukes etc.
- (iii) **Poisoning:** - e.g. when the animal ingests a toxic substance.
- (iv) **Heredity:** - An animal can inherit a disease from the parent.
- (v) **Metabolic disorder:-** e.g. indigestion or constipation.
- (vi) Malnutrition or nutritional deficiency.
- (vii) Injuries and fractures.

Signs of good/ ill-health in livestock

1. The eyes are very bright and clear, watery and runny eyes indicate ill-health.
2. The skin is smooth, pliable and shiny. A rough skin indicates ill-health.

3. Healthy animals yield good amount of milk. A drop in milk yield can be a sign of ill-health.
4. The body temperature should be about 39.5°C. Higher temperatures are for diseased animals.
5. Urine is of a pale- straw colour. Red or brownish urine indicates an abnormality.
6. Faeces are fairly loose, very hard or watery dung indicates ill-health.
7. The pulse rate of a diseased animal is always faster than that of a normal animal.
8. Diseased animals normally lose appetite.
9. Healthy animals walk with stability, lameness and sluggishness means sickness.
10. A healthy animal grazes continuously. Long standing hours and weakness means abnormality.
11. The nose is always cool and moist. Dry and warm nose can mean an abnormality.

Classification of diseases

- (i) **Infectious (contagious):-** It is a disease caused by a pathogen and can be transmitted by direct or indirect contact between animals.
- (ii) **Non infectious:-** It is a disease caused by something else than a pathogen e.g. poisoning, metabolic disorder, injuries, inheritance and nutritional deficiency such diseases cannot be spread by contact.
- (iii) **Notifiable or reportable disease:-** It is a fact, spreading acute disease that normally occurs as an epidemic. It therefore needs reporting or notifying the government. Such diseases include anthrax, foot and mouth disease, Rinder, Swine fever and Bovine pneumonia.
- (iv) **Zoonoses:-** These attack both animals and man. Examples include anthrax, T.B, rabies etc.

Others:

- **Poison and allergy.**

Once taken into the body poison may cause death. Farm animals can consume poison through improper disposal of chemical containers or by accidental eating of poisonous plants.

When animals eat poisonous plants, they develop allergic reactions. For this reason, the animals' normal body process gets disrupted for sometime. In some cases the animals die of diseases that may result from poisoning. Examples include sweetclover disease, photosensitization, cyanide poisoning and serum shock. Snake bites introduce poison into the animals' body.

- **Injuries**

Body injuries can be a cause of ill health to livestock. The open wounds created encourage entrance of pathogens. The injuries may result from fights or sharp pieces in the homestead or kraal.

- Thermal injuries.

This is common in pigs and chicks. High temperatures cause sun burn in pigs and cold temperatures chill chicks to death.

How diseases are transmitted (spread) in livestock

- (i) Through introduction of diseased animals on the farm.
- (ii) Through contact with objects such as feeders, drinkers which are contaminated.
- (iii) Through dead animals that are not well disposed.
- (iv) Through man's shoes and clothings as they can carry germs from one farm to another.
- (v) Through contaminated water and food to animals.
- (vi) By vectors such as tsetse flies, ticks, mites etc.
- (vii) Through air especially the virus air bore diseases.
- (viii) Through insemination using bad semen.
- (ix) By diseased wild animals such as warthogs.

Effects of diseases

- Retarded growth: affected animals grow slowly, reach reproductive stages late, produce low quality products reducing the income of the farmer
- Lowering quality of products; products from affected animals have bad taste for instance milk from a cow suffering from mastitis, meat from affected animals has bad texture and such products are rejected by consumers; loss of hair from hides and skins.
- Poor feed conversion rate: this leads to waste of feed as animals have no appetite. This will be unnecessary expense to the farmer.
- Increase in cost of production; buying drugs and paying for the services of veterinary Doctors is an extra cost incurred.
- Decreased reproductive efficiency; affected animals fail to conceive and to mount; continuous abortion, still births lead to fewer animals on the farm.
- Death; Notifiable diseases,

Ways of controlling disease spread on the farm

1. Regular vaccination of livestock.
2. Isolation and proper examination of new animals letting them into the farm.
3. Keeping cleanliness all round animal houses.
4. Proper disposal of dead carcasses.
5. Burning or burying excretes of dead animals.
6. Isolation of sick animals.
7. Getting breeding stock from authorized center.
8. Controlling vectors like tsetse flies, ticks and mites.
9. Properly cleaning and disinfecting the feeding and drinking containers.
10. Avoiding uncontrolled access to the farm units by visitors.
11. Use of well examined high quality semen for insemination.
12. Feeding the animals on balanced food rations.
13. Ensuring hygiene all over the farm.

14. Frequently drenching or deworming livestock.
15. Proper fencing of the farm to prevent stray animals from accessing the farm land.

SOME COMMON LIVESTOCK DISEASES

(a) Bacterial diseases

(i) Anthrax

Symptoms

- High fever (40o – 42oc temperature) and death in one day.
- Dark blood is found oozing out of the opening like anus, nose, ears etc.
- Gas forms quickly in abdomen leading to quick inflammation of the whole body

Prevention and control

- Vaccinate animals with branthrax vaccine.
- Early treatment with antibiotics such as penicillin and streptomycin.
- Disposing off dead animals completely by burning on spot or burning 3m deep.
- Impose quarantine on areas of suspected outbreak.

(ii) Mastitis (inflammation of the udder)

- Bacteria of strepto cocci/ staphylococci specie.
- Mechanical damage on the udder.

Symptoms

- Decrease in milk yield or production
- Swollen udder and teats
- High temperatures, shivering, low appetite.
- Production of clotted milk with blood stains and bad smell
- Intense udder pain when touched.

Factors affecting occurrence of mastitis in animals

- (a) **Age:** - Older animals are more susceptible than young ones probably due to longer exposure to bacteria.
- (b) **Season of the year:** - The incidence tends to increase during dry season.
- (c) **Stage of lactation:** - Incidence increase during dry period.
- (d) **Shape of teats:** - Cylindrical long teats are more susceptible than V-shaped teats.

Control

- (i) Intravenous or intramammary infection with anti biotic such as streptomycin.
- (ii) Proper and careful use of milking machines.
- (iii) Constant use of strip cup, when ever milking to detect clots in milk.
- (iv) Cows with mastitis should be milked last and the milk poured.
- (v) Constant milking i.e. about 2 hour intervals.

Other bacterial diseases include black quarter, tetanus, T.B and brucellosis.

(b) Virus diseases

1. Foot and mouth disease:-

Symptoms

- Very high fever
- Painful blisters around the mouth, udder and hooves.
- Difficulty in eating and loss of appetite.
- Reduced milk yield.

Control

- Reporting out break to authorities.
- Frequent vaccination of the livestock.
- Imposing quarantine to areas of suspected out break.
- Burning and burying diseased animals.

2. Reinder pest

Symptoms

- Fever (temperatures 40oc – 42oc)
- Animal feels thirsty all the time.
- A heavily running nose and watery eyes.
- Bloody diarrhea.
- Difficulty in breathing.
- The animal dies in 6 to 10 days if no treatment.

Control

- Annual vaccination with anti-rinder pest vaccines.
- Slaughter the affected animals very fast.
- Imposing quarantine on affected zones.
- Reporting to authorities.

3. East African swine fever (hog cholera or pig typhoid)

Symptoms

- High fever (temperatures 43oc – 44oc)
- General weakness and staggering.
- Loss of appetite.
- Constipation, followed by greenish or dark brown
- Severe coughing and difficulty in breathing.
- Drooping of the head and bunching up .

Control

- Vaccination at 6 – 7 weeks of age.
- Slaughter affected pigs immediately and disinfecting the premises.
- Proper fencing to keep wild pigs away and keeping pigs in doors.
- Warthogs and wild pig hunters shouldn't come to the farm.
- Report any suspected outbreak to government.

4. New castle (fowl pest)

Symptoms

- Coughing, sneezing, rattling and difficult breathing.
- Paralysis of nervous system and lack of muscular co-ordination.
- Gross reduction in egg laying or complete ceasation.
- Acute cases die suddenly (especially in chicks)

Control

- Regular and strict vaccination i.e. 4 days, 4 weeks, 4 months and every six months.
- Regular culling and disinfecting of the flock.
- Providing enough space and proper ventilation in poultry house.

Other virus diseases include fowl pox and Nairobi sheep disease.

(c) Protozoan diseases.

(i) Coccidiosis

Symptoms

- Whitish yellow, blood stained diarrhoea.
- Loss of weight and anemia.
- Feathers are rough and wings tend to droop.

Control

- Using coccidiostants such as sulfamethazine mixed with water and feeds.
- Disinfecting poultry houses with ammonia or NaOH.
- Proper disposal of faeces and isolation of sick cases.

(ii) East coast fever (theileriosis)

Symptoms

- High fever (temperatures up to 42°C)
- Swollen lymph glands (seen along dew lap)
- Nasal discharge and difficulty in breathing.
- General weakness and later death.

Control

- Use of anti-biotic and sulfa drugs.
- Effective control of ticks, the transmitting vector.

(iii) Heart water (rickettiosis):-

It is a tick borne disease attacking cattle, goats and sheep. It is caused by a protozoa *Rickettsia ruminantium* transmitted by the Tsetse tick.

Symptoms

- High fever

- Muscle twitching and lack of co-ordination.
- Animal shows nervousness and may walk in circles and die in convulsion.
- Post mortem shows a yellowish brown fluid in the heart and abdominal cavity.

Prevention and control

- Effective control of ticks on the farm.
- Use of tetra cycline at early identification.

Other protozoan diseases include red water and Nagana.

(d) Non Pathogenic diseases

1. **Milk fever:-** It is a metabolic disorder resulting from lack of calcium in blood stream (hypocalcaemia). It is common in cows within 3 days of calving.

Symptoms

- General weakness and shivering.
- Eyes become staining and look in different directions.
- The animals can coil pushing heart between legs.
- Excessive salivation.
- Temperatures drop to 35°C.

Treatment

- Intravenous injection of calphon (calcium).
- Feed on diet rich in calcium.

2. **Bloat:-** It is a condition where the rumen gets filled up with gases.

Symptoms

- The left hand side of the rumen gets swollen up.
- Animal loses appetite and comfort.

Control

- Avoid feeding animals on lush pastures and legumes.
- Drench with turpentine.

- Pierce left hand side of rumen with trocar and cannula to allow for escape of gases.

PARASITISM IN LIVESTOCK

A number of relationships exist between living organisms. Some of them are parasitism, commensalisms and mutualism. In this topic we shall deal with parasitism. In parasitism one organism depends on another organism but of different species and in the process causes harm. The organism benefiting is a parasite and the exploited one is the host. Therefore a parasite is an organism that derives its food from another organism.

In other words, a parasite is considered as an organism which depends on another organism (host) for its nourishment and survival when the host does not benefit at all from the association

The host organism is always bigger than the parasite and the two belong to different species. Examples of hosts and their parasites include;

- Cattle and tick.
- Pigs and worms
- Chicken and lice

. Parasitism host relationship

The host could be primary or secondary. A primary host provides attachment and development of the parasite's entire life cycle for example roundworms and cattle. As for secondary /intermediate host, the host provides conditions for further development of the parasite from one stage to another for example the miracidium larvae stage penetrate the water snail before developing into other stages. The parasite will then complete its lifecycle in another animal, the final host, which can be sheep, goats, cattle and man.

General effects of parasites on host animals

Parasites cause harm to their host depending on the way they feed. Some of the effects are given below;

- (i) They drain food nutrients from animals. For example tape worms and round worms. This results into general loss of weight [emaciation] by the host due to the feeding action. The animal [host] though fed well; its weight gain is lowered.
- (ii) Some parasites feed on body tissue e.g. suck blood. They bore holes in body organs for example the liver fluke and lung worms which damage the liver and lungs respectively.

- (ii) Some parasites cause mechanical obstruction e.g. the tape worm blocks the tracheal in chicken.
- (iii) Some, such as ticks for example the brown ear tick transmits protozoa that cause East coast fever and tsetse flies transmit disease.
- (iv) They cause irritation on animals skin/ hides. Skin irritation and as a result, the host rubs against wood and walls. This affects the quality of skins and hides. Parasites that cause irritation include ticks, lice, mites and mange.
- (v) They generally reduce the animal's growth rate especially in young ones and even cause weight loss.
- (vi) They tend to cause death in extreme cases. i.e. Cause death of animals due to inflammatory reactions e.g. Liver flukes.
- (vii) They cause anemia due to the sucking of blood.
- (viii) Some cause obstructions for examples the gape worms in trachea of chicken.
- (ix) They lead to loss of appetite, weakness and dullness.

Types of parasites

1. **Periodic parasites:** - These live on the host for a short period or occasionally. Examples include fleas and mosquitoes.
2. **Obligatory parasites:** - These live and depend on the host for the whole of their lifetime. An example is the tape worm or round worm.
3. **Facultative parasites:** - These can feed on the host during its lifetime and even after death.

Parasites that live inside the host are called Endoparasites. Examples include all worms.

Those living out of the animals body are called Ecto parasites. Examples include ticks, mites, lice etc.

External parasites (Ecto-parasites)

1. Ticks

, They belong to the class of Arachnids and order Acarina so they have eight legs. Ticks are grouped according to softness of the body or lifecycle (number of host) According to softness of the body, we have the soft ticks (Argasidae), for example the blue tick and hard ticks (Ixodidae) for example, Bont tick. On the basis of life cycle, there are three categories and these are;

- (a) One-host tick
- (b) Two-host tick

- (c) Three host tick

Identification

It is important for us to know how ticks look like and more so the type of tick. This will assist us in determining the ways of controlling them so as to reduce incidences of tick-borne diseases. In the activity below you will identify ticks.

Activity one

- Carefully observe the specimens of ticks given to you.
- Write down the observable features each specimen has in your notebook.
- With the teacher's help name all the parts of the specimens.
- Make a drawing of at least one of the ticks.
- Make a table and indicate for each specimen whether it is a soft or hard tick.

Distinguishing features.

The following features enable the tick to live as a parasite.

- (a) Four pairs of legs which enable it to move easily, searching for the host.
- (b) Pointed mouth parts (hypostome) for sucking blood from the host.
- (c) Pointed mouth parts (chelicerae) for attachment to the host.
- (d) Hard coat to protect it from damage (desiccation) / water loss.
- (e) Flat body for ease of hiding in the fur/hair.
- (f) Colour to camouflage with the coat colour of the host.

Livestock species attacked by ticks

Ticks attack several livestock species and transmit disease causing organisms. The animals usually attacked by the ticks include cattle, goats, sheep, dogs, poultry, horses, donkeys and camels.

Parts of livestock attacked and mode of feeding.

Ticks can be found on different parts on the host. Some of these parts conveniently hide the ticks. The most preferred are; ears, base of the tail, belly, between the legs, tail tip/ switch, vulva, along the dewlap and the udder. Tick attaches itself on the hide or skin of the host animal using its mouth parts and then pierces the host's body using the hypostome. It then sucks blood.

General effects of ticks on animals

When ticks attack animals, there are a number of effects they put on the animal. Some of them are outlined below.

- (i) They transmit diseases such as East coast fever, red water and heart water.
- (ii) They suck blood and may cause anemia.

- (iii) They cause mechanical damage on hides and skins.
- (iv) They make the animals restless and also lose appetite.
- (v) They cause wounds that would encourage the entry of pathogens like bacteria.

Types of ticks

Name	Grouping	Site on host	Diseases transmitted
1. Blue tick	One host	Body sides, neck, dewlap, and shoulders.	Red water
2. Red legged tick	Two host	Inside ears, under tail area etc.	Red water, east coast fever
3. Brown ear tick	Three host	Horn base, eye lids, tail, switch, ear, edges etc	East coast fever, red water etc.
4. Bont tick	Three host	Belly, udder, shanks	Heart water

Life cycle of ticks

Generally it is Eggs Larvae Nymph Adult.

1. **One host tick:** - Eggs are laid on the ground by an adult female. These hatch into larvae that cling on grass and attach themselves on the host. Here, they hatch into nymph and then adult. Adult gets engorged with blood and drops down to lay eggs.
2. **Two host tick:** - Eggs are laid on the ground and they hatch into larvae. The larvae attach on host and moult into nymph. The nymph drops, moults into adult and looks again for another host. Adult is engorged with blood and on ground to lay egg.
3. **Three host ticks:** - Eggs are laid on ground and hatch into larvae. Later attach on host and feed on it. It drops and moults nymph, which in turn looks for another host. After nymph drops off and moults into adult, which also look for another host. Adult is engorged with blood and drops on ground to lay eggs.

Controlling ticks

The population of ticks on the farm can be reduced using the following 8 methods.

Applying acaricides

When applying acaricides, farmers should make sure, the whole animal's body is thoroughly covered by the acaricide. This is common in dipping and hand spraying.

For hand dressing the acaricide is poured onto the back of the animal and spreads over the whole body.

Ticks have particular places where they hide and continue to cause problems. The illustrations below summaries the key areas which should be concentrated upon especially when hand dressing and hand spraying methods are used.

Steps to follow when hand spraying a cow.

- Spray the back.
- Spray the brisket, front legs and dewlap.
- Spray the belly and udder.
- Spray the rear, scrotum, vulva and switch of the tail.
- Spray the head, face and inside ears last.

Common acaricides used in tick control are; Delnav, Supona, Coppertox, Bayticol, Bimatraz, Bacdip, Tsetse tic, spoton, etc.

General control of ticks

- (i) Practicing rotational grazing.
- (ii) Burning pastures infested with ticks.
- (iii) Fence the land (perimeter fencing) to keep off tick carrying animals.
- (iv) Detick (pick ticks off) animals.
- (v) Practice double fencing, leaving space in between a demarcation.
- (vi) Dip animals in acaricides such as grammertox, coopertox, decatix etc.
- (vii) Spray animals regularly (about twice a week).
- (viii) Use indigenous stock resistant to ticks as bait and destroy the ticks.
- (ix) Providing adequate water and pasture to avoid animals going out.

Tsetse flies (Glossine Spp)

These are also ectoparasites which live in the wilderness. They fly from one locality to another searching for hosts. Tsetse flies have a distinctive proboscis which they use to feed. Tsetse flies are only found in the tropical region.

Identification

Since tsetse flies are very mobile, it is necessary to know how they look like so that once they surface in an area, farmers will easily get to know. In the activity below, you will closely study tsetse flies and be able to identify them.

Activity two.

- carefully look at the specimens of tsetse flies provided.
- establish how many pairs of wings, body parts and pairs of legs they have.
- Establish how many eyes they have.
- Describe their mouth parts.

Livestock species Attacked

Tsetse flies attack animals such as cattle, goats, sheep, horses, pigs and camels. They transmit Nagana to them. When they come across people, they bite them too resulting into sleeping sickness.

Parts of livestock attacked and mode of feeding

A tsetse fly will pierce any where on the skin of the animal and suck blood using its proboscis. As it sucks blood, the protozoan trypanosome which causes nagana in animals and sleeping sickness in people is transmitted.

Signs and symptoms of attack

The affected animals show some or all of the following signs and symptoms.

1. anemia
2. loss of weight /Emaciation
3. swollen lymph nodes
4. high fever (high body temperatures)
5. Body weakness.
6. mucous membranes are pale
7. restlessness
8. very dry skin/ starring coat
9. death after about 3-12 months

How to control tsetse flies

It is important to reduce incidences of sleeping sickness and nagana among farming communities. Otherwise there will be no agricultural production in areas where tsetse flies exist. The control measures include the following;

- Using trypanocidal drugs like Beremil, Anticide and Samonia to treat affected animals.
- Spraying insecticides in bushes suspected to have tsetse flies.

2. Mites: - These are whitish insects with dark legs.

They usually attack sheep, causing sheep scab, a disease characterized by a lot of itching on the animal skin.

It can be controlled by spraying with grammatox and iodine.

They do not have antennae.

Identification

In the activity below you look at mites and learn to identify them according to their features.

Activity three.

With the help of a magnifying glass,

- Carefully observe the specimens provided.
- Make a drawing of the specimen in your note book.

Livestock species attacked

A wider range of livestock are attacked by mites. These include sheep, goats, poultry, cattle, and rabbits.

Parts of livestock attacked and mode of feeding

Mites usually attack the head, neck and tail base of most animals. In poultry it is under the feathers. Mites have piercing and sucking mouth parts and use a proboscis, to suck blood.

Signs and symptoms of mite attack

- Loss of feathers in birds.
- Scaly legs.
- Anaemia
- Bleeding due to continuous rubbing against rough surfaces
- Restlessness due to itching.
- Rough or wrinkled skin / hide.
- Egg production in poultry drops
- Scabs in sheep develop causing wool to fall off.

Control of mites

Mites can be controlled by ensuring proper hygiene in animal quarters. Pesticides should be dusted on the floor and bodies of the animal. Provide layer birds with clean nests

Lice

These are wingless insects that attack many types of livestock. There are **several** species of lice. Some of them attack specific animals. For example pig lice attack pigs, head lice attack people and feather lice attack poultry.

Identification.

In activity below, you will look at some lice.

Activity four

- Use appropriate lenses to observe the specimens provided.
- Find out how many body parts and legs lice have.
- Write down the observable characteristics they have.
- Make a drawing of the specimen in your note book.

Livestock species attacked

Lice attack all livestock but the most attacked ones are pigs, poultry, dogs, birds, sheep and goats.

Parts of livestock attacked and mode of feeding

Lice attack themselves on the skin of the host using claws. Lice can be found on any part of the body but in particular where there is fur or where they can hide. Some species of lice pierce the skin and suck blood using a proboscis. Others have biting mouthparts, and use sharp mandibles to cut the skin of the host animal. Such lice can also feed on hair, dead cells of the skin (scurf) and feather fragments.

Signs and symptoms of attack

- Skin irritation.
- The skin becomes rough due to constant rubbing against rough surface.
- Loss of hair due to constant rubbing against rough surface.
- Death in young animals.
- Anaemia
- A drop in egg production.

Control of lice

- Spraying insecticides such as Bacdip on the animal.
- Keep the animal and animal quarters clean.
- Create sand baths with chemicals where animals can bathe more especially in poultry houses.
- Smear old engine oil on the body of pigs.
- Dusting the affected animals with a pesticide.
- Grooming animals.

Fleas

Fleas are wingless creatures which belong to the order siphonaptera. Their body is laterally compressed and has numerous backward directed spines. Fleas have three pairs of legs which enable them to leap a long distance.

Identification.

In the activity below, you will learn to identify fleas.

Activity 5;

- 1 Carefully search the fur of a farm animal preferably rabbits and dogs to get samples of fleas.
- 2 As you search look out for small red to black red insects which move quickly within the fur and later leap away.
- 3 Observe the fleas under a microscope to identify its major features.
- 4 Compare the features identified with those shown in the diagram above.

Livestock species attacked

Fleas attack animals like poultry, sheep, goats, pigs, rabbits and dogs. Rats are alternative hosts.

Parts of livestock attacked and mode of feeding.

All parts of the body can be attacked. Fleas are blood- sucking ecto parasites. They therefore have piercing and sucking mouthparts. As they feed, they inject saliva into the host to prevent clotting of blood. Thereafter they suck blood.

Signs and symptoms of attack

- Body irritation.
- Restlessness.
- Anaemia.

Control measures for fleas

Fleas can be controlled in the following ways;
 Spraying chemicals in the animal house.
 Creating sand baths with chemical powder.

Keds

The parasites suck partly digested food and use it for their growth and development. They possess a muscular pharynx for sucking.

INTERNAL PARASITES (Endo parasites)

Some parasites feed from inside the host. These are referred to as the internal parasites or endo parasites. They are found in the body organs like lungs, liver, kidney and intestines. Examples include roundworms, liver flukes and tapeworms.

1. Round worms:-

Roundworms are small cylindrical and unsegmented living organisms with both ends pointed. Have a soft covering, pinkish or yellowish white and their posterior end is shaped like letter C. The male is smaller than the female. They live within the intestines of the host. Examples include ascaris and hookworms.

Identification

Many times animals have worms and farmers might not be aware. It is after passing out live worms that all other symptoms may become visible. In addition; some farmers might not know signs of worm infection. It is therefore important for us to be able to

identify these worms. In addition, some farmers might not know signs of worm infection. It is therefore important for us to be able to identify these worms. In the activity below, you will observe and draw round worms.

Activity six.

- Carefully observe the specimens provided.
- Identify the specimen by way of body shape and body parts.
- Make a drawing of the specimens in the note book.

Adaptation to parasitic mode of life.

- 1 Production of many fertilized eggs.
- 2 Ability of the larvae stage to form cysts during harsh conditions
- 3 Cysts can be dispersed by wind.

Livestock species attacked

Round worms can attack any livestock kept on the farm for example cattle, sheep, poultry, rabbits and pigs.

Effects

Migrating larvae damage intestinal walls.

Parts of livestock attacked and mode of feeding.

Roundworms live in the intestines and stomach of the host. They pierce the intestinal wall and absorb digested food. The pointed mouth part is an adaptation to make them live inside the intestines.

These are nematodes

With cylindrical bodies. They attack cattle, sheep, goats, pigs, rabbits, dogs and even man.

Effects on the host

.The host animals will show the following signs and symptoms when attacked by round worms.

- Stiff dry coat.(Rough hair coat)
- Loss of weight.
- Retardation in growth.
- Rough, standing hair/fur.
- Diarrhea. (With worms in calves), blood stained.
- Dehydration and pale mucosae.
- Live worms in droppings of animals.
- Drop in yield in mature animals.
- Anemia. (Low blood levels).

- General weakness.
- Loss of appetite.

- Coughing (especially in calves).
- Blown (swollen) stomach (pot belly).
- Poor condition and emaciation.

Life cycle of the common round worm (Askaris Lumbricoider)

- (i) Eggs are laid inside the host and passed out in the dung to the ground.
- (ii) Eggs are swallowed (in food/ water) by another host and hatch into larvae in the small intestines.
- (iii) Larvae penetrate the wall of the small intestine, into blood stream to liver, heart and then to the lungs.
- (iv) After some development, the young worms are coughed into the mouth and swallowed back into small intestines, where they stay, develop into adults and again lay eggs.

Control measures for r. worms

- Isolate animals suffering from worm infection.
- Practice rotational grazing.(to break the life cycle of the worms)
- Keep grazing area clean and free of cow dung.
- Grazing areas should be well drained.
- Drench animals with anti-helminthics such as Vermox, Nizor, Zantac or Endospec 10 %.(every 4-6 weeks especially in the rainy season.)
-
- Calves should have their own paddocks.
- Calves should always graze a head of the mature cattle since they are more susceptible.
- Provision of clean drinking water.
- Harrowing pastures in dry seasons to eggs.
- Controlled burning of pastures during the dry season.
- Proper disposal of animal wastes especially in zero grazing.

2. Tape worms: - These attack pigs, man and cattle.

Tapeworms attack all farm animals but to complete their lifecycle, they require an intermediate host. Examples of tapeworms include beef tapeworm (*Taenia saginata*) and pork tapeworm (*Taenia solium*). Tapeworms have a small head called scolex. On the scolex, hooks for attachment and suckers for sucking food nutrients from the host are located.

Identification

In the activity below, you will learn to identify tapeworms.

Activity Seven

1. Clearly observe the specimen provided.

2. Compare and contrast them with the ones you have seen in activity 6 then write down your observations.
3. Make a drawing of the specimen in your notebook and label it.

Distinguishing features

- Segmented body (proglottides).
- Small head (scolex).
- Hooks for attachment.
- Suckers for sucking food nutrients.

Livestock species attacked

Tapeworms attack all farm animals but the commonest are cattle and pigs. In case the animals serve as first host then man is the final host. Other farm animals that can be affected by tapeworms are fish, goat, sheep and donkeys.

Parts of livestock attacked and mode of feeding.

Tapeworms attach to the intestines of the host with the help of hooks on the scolex. They use suckers to suck food materials already digested by the host. In the intermediate host, tapeworms exist as bladder worms in the muscles of the host up to when the final host takes them in half cooked meat.

Adaptation of Tapeworms to their Mode of Survival.

- They possess hook for attachment on the gut lining.
- They produce mucus for protection against digestion.
- They have suckers for sucking digested foods from the gut.
- They flattened bodies for effective accommodation and gaseous exchange.
- Have resistant and thick cuticle to resist being digested by enzymes.
- They produce a tough brown secretion which protects the eggs from drying out.
-

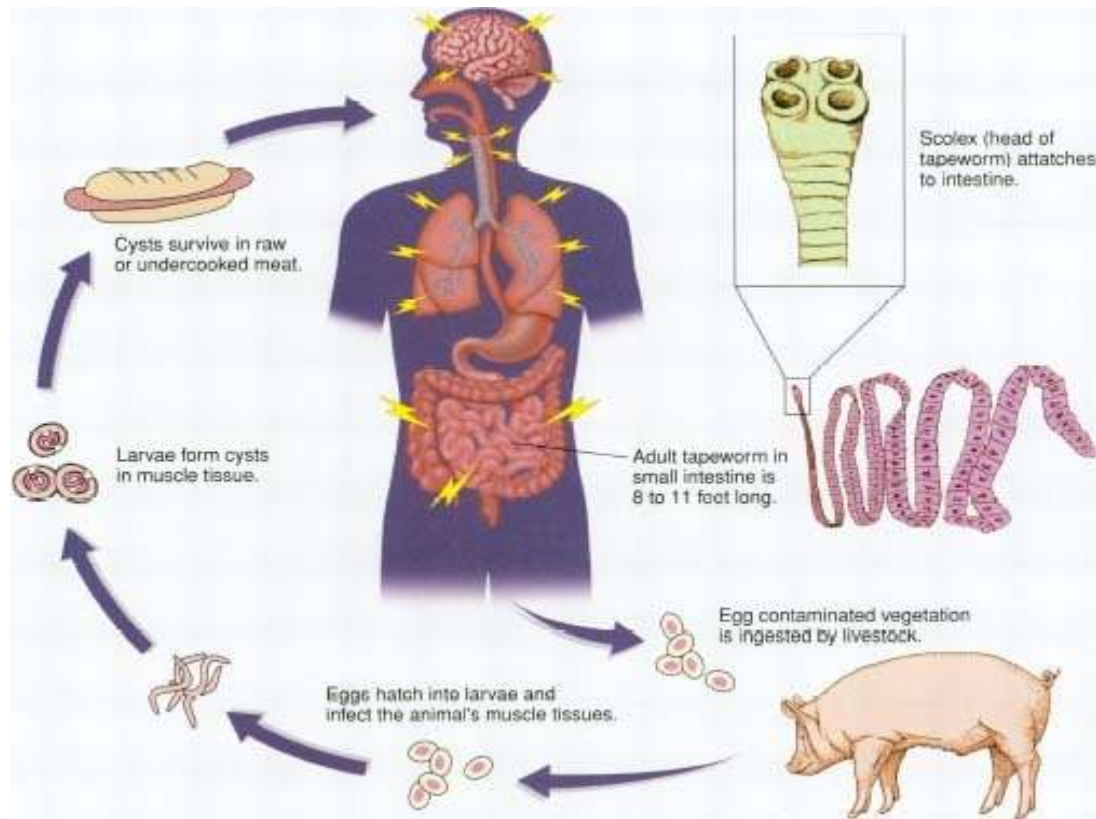
Two types

- (i) Beef tape worm (*Taenia signata*)
- (ii) Pork tape worm (*Taenia solium*)

Life cycle of the pork tape worm

- (i) Proglottides with fertilized egg break off inside man and are passed out with faeces.
- (ii) Pigs eat these eggs when grazing.
- (iii) Embryo hatch and penetrate the small intestines into blood stream to muscles where embryos develop into bladder worms.
- (iv) Man eats bladder worms in ill cooked pork. These attach themselves on small intestines where they develop to maturity.
- (v) The tape worms again lay eggs and are passed out in proglottides contained in faeces.

Diagrammatic representation



Note: It should be noted that it requires two hosts to complete the cycle. For the beef tapeworm, the first host is cattle and for the pork tapeworm it is a pig. For both parasites, the final host is man.

Signs and symptoms of Attack

- Diarrhea.
- Anemia
- Mature segments in droppings of a secondary host.
- Excessive appetite.

- Bladder worms emerge from meat when it is soaked in paraffin.
- Thin ridge back.
- Rough hair coat.
- Emaciation.

Control measures

- Animals like pigs and cattle should be deformed with sulphate and 40% nicotine.
- Meat should be thoroughly cooked to destroy the bladder worm.
- Meat should be well inspected before consumption.
- Human excreta should be disposed in latrines.
- Inspection of carcasses before selling meat.
- Burning pastures to destroy ecospheres.

FLUKES

These are flatworms that belong to the class of Trematoda. Many types of flukes exist as parasites for example liver flukes. (*Fasciola Spp*), Lung flukes and stomach flukes.

Identification.

Farmers may sometimes fail to know that their animals are affected by flukes. This may result into death of animals. It is therefore important to identify them.

- Carefully observe the specimens provided.

Activity four.

- Take note of any special features of the specimen.
 - Compare and contrast them with the round worms and tapeworms.
- From the above activity, you must have found out that flukes have flat, oval body shape like a leaf, grey or yellowish white colour and two suckers on the head.

Livestock species Attacked.

Flukes mainly attack cattle and sheep. Usually this occurs when animals drink stagnant water containing cercaria. Similarly animal grazing on pastures in waterlogged areas are highly affected.

Parts of Livestock Attacked and Mode of feeding.

The part which any given fluke attacks depends on the species. Some attack the liver (liver flukes) and others lungs. Liver flukes are usually found in the liver, spleen and bile duct. Flukes feed on already digested food within the host's organs by sucking.

Signs and symptoms of Attack

The animals affected show the following signs and symptoms.

- Loss of weight / emaciation.
- Retarded growth especially in young animals.

- Anemia.
- Dullness and sluggish movement.
- Oedema (swelling between the jaws).
- Flukes in liver of slaughtered animals.
- Diarrhoea / digestive upsets
- Coughing incase of lungworms.
- Increased breathing rate for lungworms.

Damages of liver flukes on Animals.

- Make tunnels in the liver and spleen.
- Causes liver rot due to tunnels formed.
- Blocks the bile duct.

The above damages lead to the following;

- Rejection of the liver on the market hence less income to the farmer.
- Interference with metabolism within the animal resulting in loss of condition.
- Control requires expenditure of money therefore increasing cost of production.

Controlling liver flukes.

- Deworming animals regularly using drugs like Nilzan, Sodium sulphate, Carbon tetrachloride and Ramide.
- Draining swampy areas which are near to grazing land.
- Keeping animals away from swampy areas by fencing.
- Burning infected areas to kill water snails
- Spraying affected areas with copper sulphate 1 ppm.
- Rearing ducks to pick and eat the snails.
- Hand picking the snails and killing them.

General Measures Taken to Control Internal Parasites

- Eradication of alternate hosts such as the water snail by spraying the affected areas with copper sulphate solution.
- Regular deworming with appropriate antihelminths.
- Draining or burning affected swampy areas to kill the snails.
- Sanitary measures in animal houses and proper disposal of excreta.
- Rotational grazing
- Fencing off marshy areas where there is stagnant water.

DIAGNOSTIC QUESTIONS.

- 1 Write three examples of parasites and their hosts.
- 2 How do parasites affect their hosts?
- 3 With the aid of diagrams describe the following life cycles of
 - (a) Beef tape worm.
 - (b) 2- Host tick.
 - (c) Liver fluke

- 5 List down the different methods used in the control of ticks.
- 6 Why are tsetse flies a problem in an agricultural community?
- 7 Outline the symptoms of tsetse fly attack in animals.
- 8 State the general methods used to control internal parasites.

FARM STRUCTURES, TOOLS AND MACHINERY

FARM LAYOUT

Farm layout is the way the farm is planned and set up. It refers to the way roads, fences, paddocks, vegetable gardens, farm stores, workshops and fields are positioned on the farm.

Benefits of a proper farm lay out

- (i) It facilitates proper conservation of soil, water and plant nutrients.
- (ii) It permits easy control of animal parasites and diseases.
- (iii) There is an easy control of crop pests and diseases in the field
- (iv) It facilitates easy drainage of the agricultural land.
- (v) It facilitates the practice of rotational grazing and crop rotation on the farm.
- (vi) The farmer is able to estimate the right amount of agricultural chemicals e.g. fertilizers, insecticides, fungicides and herbicides without wastage.
- (vii) Proper positioning of roads facilitates easy accessibility during supervision and transportation.
- (viii) The use and maintenance of farm machinery is properly controlled.
- (ix) It enables the farmer to calculate the crop yield per unit area, thus estimate returns.

Factors considered when planning a farm layout and sitting farm buildings

1. **Topography:** - Farm buildings should be on top or on gentle slopes. They lloppe on steep slopes and become damp in depressions.
2. **Accessibility:** - Farm buildings, vegetable plots and animal pens should be well accessed by the farmer. This facilitates easy transportation of farm input and out put.

3. **Water source:** - It is required for livestock use, irrigation and domestic work. The source should be permanent such as borehole, weirs, running streams etc.
4. **Power source:** - A source of power in form of electricity should be considered purposely for food processing.
5. **Drainage:** - Farm buildings and roads should be sited on well drained soils to avoid dampness and destruction.
6. **Soil fertility:** - Buildings should be sited on unproductive barren soils. The most fertile should be left for perennial crops and vegetable production.
7. **Wind direction:** - To avoid destruction, farm buildings should not be sighted in direction of scorching winds.
8. **Centrality:** - Buildings are most conveniently sited in centre of the farm to ensure easy supervision.
9. **Direction of sunlight:** - Ensure that hot rays of the sun especially at sunrise and sunset do not enter farm buildings.
10. **The size of the farm:** - The bigger the farm, the more the structures and enterprises established.
11. **Security:-** Poultry units, dairy sheds, crop and tool stores should be close to the main farm house for protection against thieves and wild animals.
12. **Purpose of buildings:-** Buildings with similar functions should be appropriately placed close to each other to minimize labour requirements and increase planning efficiency.
13. **Allowance for future expansion:-** Since the farm is expected to keep growing, there should be some land set aside for future expansion.
14. **Personal wishes:** - This involves the farmer's personal thinking and wishes as he plans for his farm.

FARM STRUCTURES

These are physical structures set up on the farm for general purpose of improving production efficiency. They include fences, farm buildings

1. Fences

It is a physical structure set up to form an enclosure around the farm.

Importance of fencing on the farm

- (i) It helps to demarcate farm land thus prevent disputes.
- (ii) Fences facilitate easy control of ticks and internal parasites among livestock.
- (iii) It helps in the control of grazing on the farm.
- (iv) It gives privacy to farm homes.
- (v) It provides security by keeping off thieves and trespassers.
- (vi) It facilitates isolation of sick, young, pregnant and weak animals from the mature and healthy.
- (vii) Fencing enables the farmer to practice mixed farming.

- (viii) Fences confine animals for specific operations such as drenching, castration etc.
- (ix) They keep off wild animals that would spread diseases and also attack livestock.
- (x) They facilitate protection of water sources from contamination.
- (xi) Some fences also add value and beauty to the farm.

Limitations of fencing

- (i) Fencing materials are very expensive.
- (ii) Fencing requires a lot of labour to carry out.
- (iii) They restrict animals from free feeding.
- (iv) Too many fences subdivide land, making it difficult for mechanization.
- (v) Fences can prick and cause injury to animals.

Types of fences

1. Live fences or hedges
2. Dead fences
3. Live fences or hedges are usually plants planted in line forming a continuous barrier.

Common plant species used for this purpose include

- (i) Kie apple
- (ii) Acacia
- (iii) Cypress trees
- (iv) Cactus (opuntia spp)
- (v) Sisal
- (vi) Gum trees
- (vii) Mountainous thorn
- (viii) Tick berry (lantana camera)

Advantages of live fences (hedges)

- They are long lasting
- There are no risks of termite damage or rotting.
- They are quite cheap to establish.
- They add beauty to the farm.
- They act as wind breaks
- They are quite easy to maintain once established
- They usually serve as a source of wood fuel for farmers after trimming.

Disadvantages of hedgers.

- They take long to establish.

- They are easily destroyed by pests, diseases and fire.
- They require adequate protection to facilitate their establishment when still young.
- Hedges compete with crops for nutrients, space, sunlight, and water.
- They often lack continuity hence necessitating gap filling.
- They are a breeding ground for rodents, vectors, and snakes
- Hedges require a lot of Labour in terms of maintenance e.g. trimming and pruning.
- Their establishment is affected by soil fertility and the climate.
- Thorns can pick and hurt animals, thus reducing quality of hides and skins
- Some shrubs like kie apple and lantana camera are poisonous to livestock.

Dead fences.

These include;

- (a) Wooden fence
- (b) Trenchers
- (c) Wall fences
- (d) Electric fences
- (e) Barbed wire fences
- (a) Wooden fences.**

Wooden is a common material used for making both wooden and wire fences.

Advantages of using wood for fencing.

- (i) Wood is strong and durable if well treated.
- (ii) It is relatively cheap to buy.
- (iii) Wood is always available in most parts of Uganda.
- (iv) It can be easily worked into any shape without much skill and difficulty.
- (v) Wood can be well painted for better appearance.

Disadvantages of using wood.

- (i) It easily be destroyed by termites and others insects.
- (ii) It is easily destroyed by fire
- (iii) It can decay due to fungal attack and dumperen
- (iv) Weather elements like rain, wind or temperature can affect it.
- (v) It gets damaged when baddy seasoned or treated.

Sources of wood for fencing.

- Natural forest.
- Planted forest
- Local shrubs and bushes
- Imported woods

Treatment of wood for fencing.

Seasoning: - It is the drying of fresh wood by allowing air to pass over it.

Precaution taken when seasoning wood.

- (i) Wood should be well sheltered to keep off rain and sunshine
- (ii) Timber should be heaped in intake and supported off ground to avoid dampers
- (iii) For easy air circulation.
- (iv) All supports should be closely spaced to bear the weight of the timber and avoid bending or warping.

Chemical treatment of wood

Chemical that can be used for this purpose are.

- Penta chlorophenol
- Old engine oil
- Dieldrine
- Arsenic pent oxide
- Sodium dichromate
- Tar

- Creosote etc

Methods of chemical wood treatment

These include;

1. Vacuum/ pressure treatment
2. Soaking methods (hot and cold soaking)
3. Sap displacement (end diffusion) methods

1. Vacuum/ pressure treatment

In this method, timber is peeled and tightly packed in a large cylinder, where the chemical (preservative) is forced into the wood at high pressure.

The chemical enters every part of the timber. The method is very effective and required special equipment.

2. Soaking methods

(a) Hot soaking: - Freshly cut and peeled pole are submerged in a container containing the preservations.

The container is then heated until the preservative is about to boil, then heat is removed and timber allowed cooling down in the preservative.

The wood cells that expanded during heating now shrink during the cooling process and draw up the preservative.

(b) Cold soaking: - The posts are submerged in the cold preservative for 2 or 3 days to allow the chemical to be slowly drawn into the conducting tubes of wood.

3. End diffusion (sap displacement) method

In this method, freshly cut posts are peeled and immediately packed, with their bottom ends dipping in the chemical contained in a vessel.

After about 10 days, they are turned to submerge the ends also in the chemical until the chemical is taken in sufficiently.

The method is called sap displacement because the preservative is drawn up into the wood by displacement of the sap that dries out through the transpiration stream.

N.B:- It is thus necessary to submerge the wood just within 2 hours after cutting before the sap dries up.

(b) Trenches

A deep trench (ditch) is dug along the perimeter of the farm land. Trenches are commonly used in areas near national parks or game reserves where wild animals are a problem.

Advantages of trenches

- They are not difficult to maintain once established.
- Their establishment does not involve special technical skills.
- It is a cheap way of preventing wild game.

Disadvantages

- Digging the trenches is expensive and laborious.
- High leaping animals cannot be restrained.
- Trenches can act as breeding ground for mosquitoes and snakes.
- The domestic animals may drop inside and get fractured.

(c) Electric fences

This is made of conducting material, where a low voltage is usually set to provide a simple electric shock to animals that come into contact. Electric fences are common on farms where strip grazing is practiced.

Advantages

- Its effective to cattle and goats
- It allows for adequate control of animals in strip grazing.

Disadvantages

- Initial installation cost is very high.
- The cost of maintenance is also high.
- It is inefficient in case of power failure.
- It does not effectively restrain wool coated animals such as sheep and some goats since their coat are insulators.

(d) Wall fences

These are constructed using bricks or blocks joined with mortar.

Advantages

- They give maximum security and privacy.
- They are long lasting.
- They are resistant to pests, weather and fire.
- They are cheap and easy to maintain once established.

Disadvantages

- They require technical expertise in construction.
- The construction material is very expensive.

(e) The barbed wire fence

These are the most common fences found on farms in East Africa. They have lines of wire (strings) usually 3 – 6 and supported on wooden posts.

Types of barbed wire

- (a) Low tensile barbed wire:** - This is always thicker in diameter and is more brittle. Its spines are usually blunt.
- (b) High tensile barbed wire:** - Its spines are always sharp and small.

Components of a barbed wire fence

- (i) Strainer or king posts:** - These are large posts, 2.2m high, 15cm diameter, and usually set 75cm into the ground. They are usually set at corners and gate

The purpose of the strainer is to strain or pull the wire in the required direction.

- (ii) **Standards or intermediate posts:** - These are 1.7m high, 10cm diameter and usually set 60cm into the ground. They are usually set at 4.5 – 6m intervals.

The purpose of the standard post is to hold up wires between strainers.

- (iii) **Struts or supporters:** - These are used to support or prop the strainers into the ground.
- (iv) **Droppers:-** These are wooden pieces 3 – 4cm diameter, supported on strands at 1 – 2m intervals. They don't touch the ground.

The purpose of the dropper is to keep the spacing between strands.

Fence construction

Equipment: - These include; tape measure (For determining the spacing of the posts), wire strainer (used to strain /tension wire. This helps to avoid sagging of the wire), hole diggers/Earth auger (For boring holes), wire pliers (to cut and bend wires), claw hammers (installation of staples), pegs (identify and locate corners), staples (used to fix the wire onto the posts), mallet, twine, nails, posts and wires.

Procedure

- (ii) Ensure that the land to be fenced is the right one.
- (iii) Clear the land where the fence line is to pass to a width of about 2m to allow ample working space.
- (iv) Identify the corners of the area and use pegs to locate these positions.
- (v) Make straight lines from corner to corner using twine.
- (vi) Fix corner and gate posts with their struts, taking care of foot paths. Strainers should be fixed 200m – 400m intervals along straight lines.
- (vii) Fix the standards at 4.5 – 6m intervals, setting them 60cm deep.
- (viii) Fix wires, starting with the bottom strand. The numbers and spacing of strands depends on the size of animals to be confined.
- (ix) Fix the droppers on the strands at intervals of 1 – 2m.

Determination of quantity of fencing material

1. Number of posts

$$= \frac{\text{Fence perimeter}}{\text{Spacing between posts}} + 1$$

Where 1 is a constant

N.B:- For struts, each corner post requires 2units while each gate requires 4 posts, each with one strut.

Thus Number of struts = (2 x Number of corner posts) + (4 x Number of gates)

2. Number of rolls of barbed wire

$$= \frac{\text{Perimeter} \times \text{number of strands}}{\text{Length of 1 roll of wire.}}$$

3. Number of staples = Number of strands x number of posts.

Example

Mr. Kirevu is to fence his rectangular farm with 4 more strands. The farm is 2000m long and 1000m wide. He wants to fix 3 gates if spacing between posts is 15m as gates;

Calculate

- (i) Number of posts required along the normal fence line.
- (ii) Number of struts required.
- (iii) Number of rolls required, assuming/ roll is 600m long.
- (iv) Number of staples required.

Solution

(i) Number of posts = $\frac{\text{Perimeter}}{\text{Spacing}} + 1$

$$\begin{aligned}\text{Perimeter} &= (1000 \times 2) + (2000 \times 2) \\ &= 2000 + 4000 \qquad \qquad \qquad = \mathbf{6000m}\end{aligned}$$

$$\text{Thus number of posts} = \frac{6000}{15} + 1$$

$$\begin{aligned}&= 400 + 1 \\ &= \mathbf{401 \text{ post}}\end{aligned}$$

(ii) Number of struts = (2 x Number of corner posts) + (4 x Number of gates)

$$\begin{aligned}&= \frac{2 \times 4}{8} + \frac{4 \times 3}{12} \\ &= \mathbf{20 \text{ struts}}\end{aligned}$$

(iii) Number of rolls = $\frac{\text{Perimeter} \times \text{Number of strands}}{\text{Length of 1 roll}}$

$$\begin{aligned}&= \frac{6000 \times 4}{600} \\ &= \mathbf{40 \text{ rolls}}\end{aligned}$$

$$\begin{aligned}
 \text{(iv) Number of staples} &= \text{Number of strands} \times \text{Number of posts} \\
 &= 4 \times 401 \\
 &= \underline{\underline{1604 \text{ staples}}}
 \end{aligned}$$

Example two.

Mr. Oryang has a rectangular piece of land measuring 1500 meters by 600metres around which a four strand perimeter barbed wire fence is to be constructed.

If the length of the barbed wire is 600m, and spacing between the fence posts is 5metres and no gate should be provided, Calculate;

- (a) The number of fence posts required.
- (b) The number of rolls required.
- (c) The number of staples required.
- (d) If the cost of one roll of barbed wire is 60,000/=, calculate the total cost.

Solution;

(a) Calculate first the perimeter of the land.

$$\text{Perimeter} = 2(\text{length} + \text{width})$$

$$P = 2(1500 + 600)$$

$$P = 3000 + 1200$$

$$P = \underline{4200\text{M}}$$

But, the spacing between the poles is 5 Metres.

$$\begin{aligned}
 \text{Therefore, the number of poles} &= \frac{4200}{5} \\
 &= 840
 \end{aligned}$$

$$\text{But the actual number of poles is given by } = \frac{\text{Perimeter} + 1}{\text{Spacing}}$$

1 is a constant.

$$\begin{aligned}
 \text{So perimeter} &= \frac{4200}{5} + 1 \\
 &= 840 + 1 \\
 &= 841 \text{ Poles.}
 \end{aligned}$$

$$\text{Number of rolls} = \frac{\text{Perimeter} \times \text{Number of strands}}{\text{Length of 1 roll/size of rolls of wire.}}$$

$$= \frac{4200}{600} \times 4 = \frac{16800}{600} = 28 \text{ rolls}$$

$$\text{Number of staples} = \text{Number of strands} \times \text{Number of posts}$$

$$= 4 \times 841 = 3364 \text{ staples.}$$

If the cost of each roll was 60,000#, but from the above calculation will have 28 rolls, then the total cost on wire is $28 \times 60,000 = \underline{1,680,000\#}$

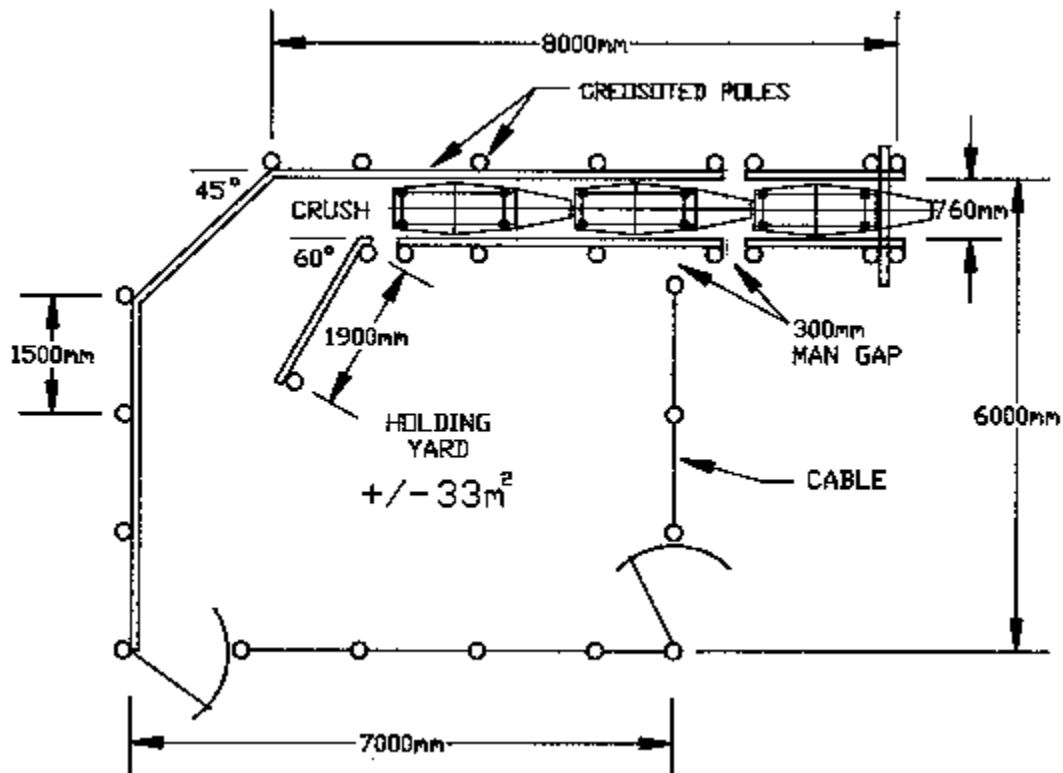
ANIMAL HANDLING STRUCTURES

These structures are mainly used on the farm for carrying out special operations on the animals. They include: cattle crush, spray race, milking parlour and cattle dip.

The cattle dip

This is an animal handling structure used in the control of external parasites such as ticks by dipping. The animals are totally submerged in a dip wash in a plunge dip.

Structure and parts of the dip



Parts of the dip

- (i) **Collecting yard:** - It is a spacious place where animals collect before dipping.
- (ii) **Foot bath:** - It is a shallow depression, (15cm deep and 35cm wide), filled with copper drugs to cleanse the feet of animals before dipping. This prolongs the strength of the dip wash.
- (iii) **Entrance race:** - It can have 2 or 3 steps or not at all. Its 4m long and 1m wide. It provides a point at which animals plunge into the acaricide.
- (iv) **The dip tank:** - Its 5m long, 205m at the deepest and 1.6m at the shallowest point. It is where the acaricide is contained.
- (v) **Splash walls:** - These are walls on sides of the tank. They return acaricide splashes back to the dip.
- (vi) **Cat walk:** - It is a floor between splash walls and other side of the roof on which the pharmacist stands to observe the dipping process.
- (vii) **Roof/ shed:** - It prevents excessive evaporation of the dip wash and keeps off rain water from diluting the wash.
- (viii) **Exit ramp:** - It has got up to 12 steps rising from the dip bath. It lets animals out.
- (ix) **Drainage race:** - It is the passage of animals from the exit ramp. It is long and slopping towards the exit ramp to facilitate easy back flow of acaricide dripping from animals.

Examples of acaricides used as dip wash

- (i) Gammertox
- (ii) Toxaphane
- (iii) Decetix
- (iv) Delner
- (v) Bimatranz
- (vi) Tsetse tick
- (vii) Cooper tox

- (viii) Supons
- (ix) Supar mix
- (x) Supona extra

Essentials of a cattle dip

- (i) It should be sited on a well drained land with ample space for animal handling.
- (ii) It should be near a permanent water source.
- (iii) All floors should be concrete for easy cleaning and avoid muddy conditions.
- (iv) The dip tank should be well roofed to keep off rain water and reduce excessive evaporation.
- (v) It should be well fenced for protection when not in use.

Precautions taken when dipping animals

- (i) Dipping is best done in the morning when the weather is still cool.
- (ii) Animals should be watered before dipping or else they will drink the poisonous acaricide.
- (iii) Before dipping, the foot bath should be clean and filled with fresh copper drugs.
- (iv) The correct concentration and level of acaricide should be ensured before and during the dipping.
- (v) Sick, weak and terminally pregnant animals should not be dipped. They should only be sprayed.
- (vi) Ropes should be at hand as to pull out animals that would collapse in the dip.
- (vii) One animal should be allowed to enter the dip at a time.
- (viii) Adult animals should be dipped separately from heifers.

Advantages of using the dip

- (i) Large volumes of acaricides enable handling of many animals in a short period of time.
- (ii) The dip wash can be used several times once its concentration is maintained.
- (iii) There is no wastage of acaricide.
- (iv) On immersion, the acaricide reaches every part of the animal.
- (v) It requires less technical skill to carry out the dipping process.
- (vi) The dip is quite cheap to maintain once established.

Disadvantages of the dip

- (i) The initial cost of construction is very high.
- (ii) Sick and pregnant animals cannot be treated.
- (iii) Much labour is required when filling and emptying the wash manually.
- (iv) There is a risk of leakage of the wash in case of crack at the base and in the walls of the tank.

- (v) The wash tends to get too dilute as many animals are allowed through the dip.
- (vi) Bacterial and virus diseases can accumulate in the dip and be transmitted to animals.

DIP TANKS

They are of two types and these include;

- Mechakokos dip tank developed for small scale farmers and is mostly used in Kenya.
- Plunge dip which handles a large number of cattle and is the most popular type. It is constructed of bricks or stone and has strong walls that are plastered with cement on sides to avoid cracks and facilitate the return of the splashed dip wash. Its capacity is 14,000-22,000litres.

Construction procedure;

-It involves digging a trench in the ground 1.2M wide at the Surface, narrowing down to 60cm width at the base. The length of this trench should be 5M at the base up to the slopping exit (ramp) whose horizontal distance up to the ground level is 2.5m. The dip wash is contained in this area.

- A corrugated roof is provided.

- An entrance race as well as an exit race are provided. These have concrete floors that of the exit race slants backwards to allow the dip wash return to the dip tank

Dip filling:

- Choose the right type of acaricide to use. Then follow the manufacturer's instructions strictly in order to obtain right dilution of chemicals. The capacity of the tank is measured by calibration so that the amount of acaricide to be used can be calculated.
- The recommended mixing ratio is 1; 500.

Dipping operation;

- The animals are assembled in the collection yard which should be a hard surface to reduce mud from the animal's hooves.
- The animals are led in a single file through the entrance, across the foot bath to wash their hooves. They then jump into the plunge and get immersed in the dip wash, swimming across to the slopping exit.
- They walk out and are held in the exit race until excess acaricide has dripped off when the crush is full; they are allowed to leave singly.
- Dipping must be done at least once in a week. Though if there is an outbreak of tick bone disease it should at least be done twice a week until the situation normalizes.

Factors that can reduce effectiveness of dipping

- (a) Failure of the farmer to follow the dipping routine.
- (b) Use of a wrong concentration of acaricide, usually too weak.
- (c) Poor mixing of acaricide which may not achieve uniformity of the mixture.
- (d) Dipping on rainy day and rain water washes off the acaricide before it dries on animals.

(e) Leaking roofs may lead to dilution of acaricide lowering effectiveness.

The cattle crush

It is a structure used for confining animals when carrying out different operations.

Designs of a crush



(i) The V Shape



(ii) The H Shape

Side elevation

Essential of a good crush

- It should be sufficiently strong to restrain any animals put inside.
- The space should be limited not to allow more than one animal to enter.
- It should facilitate use of minimum labour when handling animals.

For effective handling of an animal, the head should be well secured on to a bar or the nearest post.

The crush should have a concrete floor built to a height of 0.6m on either side.

Reasons for a concrete floor

- It enables easy cleaning.
- It is durable.
- It with stands heavy damage due to tear and wear.
- It protects animals feed from injury.
- It avoids muddy conditions.

Uses of the crush

Used to confine animals during these operations

- Spraying
- Vaccination
- Drenching
- Artificial insemination
- Castration
- Dehorning
- Milking
- Identification

The spray race

It is an enclosed structure in which animals are expected to get a dense spray of acaricide delivered at high pressure from a system of appropriately arranged nozzles.

The solution of acaricide is drawn from a reservoir by pump operated by an external power source.

Components of a spray race

- Collecting yard
- Spray pipe system
- Guide rails
- Pump
- Side Walls
- Jump (reservoir)
- Drainage race

Advantages of a spray race over a cattle dip

- (i) It can spray small stock e.g. sheep and goats.
- (ii) Pregnant, sick and weak animals can be treated.
- (iii) It uses only a small quantity of acaricide that can be made each day.
- (iv) It is cheaper to install than the dip.
- (v) Less labour is used in the operation.
- (vi) The acaricide is always fresh and of high concentration.

Disadvantages of the spray race

- (i) It requires better technical skill in the maintenance.
- (ii) It can't operate without a power source.
- (iii) There is wastage of the acaricide.
- (iv) Nozzles are always blocked with dirt, reducing its efficiency.

FARM BUILDING AND CONSTRUCTION MATERIALS

These are enclosed roofed structures built on the farm.

Benefits of farm buildings

1. They increase production by decreasing crop and animal losses due to rotting, pest and fungal attack.
2. They increase on the quality of farm produce.
3. They protect farm tools and machinery from bad weather that would cause rusting.
4. They protect sick, young and weak animals from bad weather.
5. They facilitate practices like zero grazing and other intensive methods of livestock grazing.
6. They facilitate storage of crop products when prices are low and sell when prices increase.
7. They facilitate proper storage of farm input such as insecticides, fungicides and fertilizers before they are used.
8. They increase security of farm produce against thieves and wild animals.
9. They reduce disease transmission on the farm by vectors like tsetse flies.

Site selection for farm buildings.

Farm buildings form an integral part of the farm business, so it is important that suitable sites are chosen. This is usually the work of the farm manager.

The following considerations should be borne in mind.

- **Accessibility:**

Farm buildings should be sited in the centre of the farm. This facilitates accessibility and communication from all parts of the farm and easy supervision of various activities.

- **Gradient :**

Location of farm buildings on high ground with gentle slopes is desirable to allow free drainage and good view of the farm.

- **Soil type;**

The area selected should have well drained soils to avoid water logging, runoff and accumulation of trash. It should also be firm enough to afford strong foundation.

- **Water**

The farm buildings should be located near water sources.

- **Power source;**

It is important to locate farm buildings near power line.

- **Direction of major prevailing winds**

Farm buildings should be located on the leeward side of the farm while on the windward side of the windbreak should be planted. Stores for inflammables such as petrol or diesel should be constructed downwind of other units and at some distance from the.

This arrangement applies to enterprises such as poultry and pigs which may produce bad smells. These units should be constructed in the East-west sun line.

- **Allowance for future expansion**

There should be land set aside for future expansion.

- **Relationship of certain buildings to others.**

It is important that buildings with similar or related functions are sited near each other to minimize labour requirements and also increase planning efficiency.

Materials used for construction of farm buildings

- (i) **Wood:** - Used as timber for poles, purline, beams etc. it is also used as shatters for doors and windows.
- (ii) **Mortar:** - It is a mixture of cement and sand in ratio of 1:3 or 1:4 with water added. It helps in binding bricks or blocks during construction.
- (iii) **Concrete:** - A mixture of sand, cement and gravel strong concrete, then 1:2:4 for floors. Where reinforcement is required, steel bars are put to make lintels and beams.
- (iv) **Metal:** - It can be used in form of bars, pillars, poles, pipes, nails, netting frames and roofing sheets.
- (v) **Blocks:** - It is a mixture of cement, sand and gravel in a ratio of 1:2:3, used in making walls and foundations.
- (vi) Others include bricks, thatch, bamboo etc.

Major components of a farm building

1. Floor and foundation
2. The wall
3. The roof

1. Floors and foundation

Procedure of making a concrete floor

- (i) Lay hard core (big hard stones) when the foundation comes to the ground level.
 - (ii) Lay a binding layer of sand on top of the hard core and compress it well to get rid of empty spaces.
 - (iii) Pour silt concrete or ratio 1:2:4 on top of the sand layer.
 - (iv) Add a layer of cement/ sand mixture (ratio 1:8) on top of the concrete layer and introduce a little water to make it damp.
 - (v) If the floor is to be smooth, put only a coat of wetted cement, finishing it with a steel float.
- The floors of most farm buildings are lower completed with rough finish to avoid sliding.

Procedure of making a foundation

- (i) Prepare the site by removing all vegetation, trash and tree roots.
- (ii) Make the necessary measurements according to building plan.
- (iii) Locate the outline of the building using pegs/ strings.
- (iv) Dig a trench 35cm wide and about 60cm deep all round.
- (v) Lay hard core (stones) in the trench.
- (vi) Mix concrete (cement, sand, gravel) in ratio, 1:3:6 or 1:2:3 and pour on top of hard core in the trench all round.
- (vii) Lay the bricks (wall construction) on top of the dry concrete using mortar of ratio 1:6 to join the bricks. The foundation (plinth) wall should be raised to a level of about 15cm above the ground.

Other important features of the building

1. The damp course paper. (D.C.P)

Its thick, rough sheet usually placed on top of the foundation wall before construction of the main wall.

Importance of D.C.P

- It prevents termite filtration into the main wall.
- It cuts off moisture (dampness) from the ground.
- It improves durability and strength of the main wall.

2. The lintel

It is a bar of steel reinforced-concrete (mix 1:2:3)

Established just above windows and doors, to form a connection through the wall units.

Importance

- It forms a loop that holds the wall of the building together.
- It strengthens the wall against tensional and compressional forces from all sides.

TYPES OF FARM BUILDING

- (i) Crop store
- (ii) Animal houses
- (iii) Tools and equipment stores
- (iv) Farmers house
- (v) Garage

Crop store

Importance of crop store

- They reduce losses due to pests
- They reduce losses due to environmental hazards e.g. rain and humidity
- Facilitates prevention of crop produce till prices become reasonable.
- Facilitates easy inspection of crop products
- Make food available throughout the year.

Common problems associated with crop storage.

- Lack of proper storage facilitates e.g. cube, bini and bag.
- Lack of proper seed dressing techniques
- Insects and rodent damage
- Deterioration due to rotting and fungal attack
- Poor construction of crop store.

Desirable features of a good crop store

- (i) Should be raised about 50cm above ground to avoid deepness.
- (ii) All pests, pillars and wall should have smooth surface.
- (iii) It should be made vermin proof e.g. by use of deflection
- (iv) It should be well roofed and leak proof.
- (v) It should be positioned where there is security from thieves, wild animals.
- (vi) All part should be accessible for easy cleaning.
- (vii) It should be established on a firm well drained ground.

Essentials of a good calf house

- It should be on a well drained site
- It should have good ventilation.
- It should have a good supply of sun light.
- The roofing should be proper to protect animal from rain

Farm water supplies;

All farming practices need supplies of available water of good quality and in large quantities. The water supply system ensures the conveyance of water from the sources to the place of consumption or use. Available water for the farm therefore has to be collected, stored, may be treated and distributed to the points where it is required.

Qualities of clean water

- Should be free from suspended sediment
- Should be very clear
- Should be free from odors and taints
- Should be free from pathogens e.g. bacterial, fungi and protozoa
- Should be free from toxic chemicals like pesticides, herbicides and fertilizers

Importance of farm water.

- All humans and livestock require water regularly for drinking.
- All growing crops need water; therefore water is needed for irrigation of crops especially in drought.
- Washing of farm machinery, equipment, tools and utensils needs water. In addition the regular sanitation operations associated with livestock and their housing use a large quantity of water.
- Water is used for mixing various solutions (suspension or emulsion) of farm chemicals. eg. Pesticide.
- Cooling is achieved by the evaporation of water from a surface. Perishable products such as milk and fresh vegetables can be kept cool. Farms may have a variety of engines which are water cooled as opposed to air cooled.

- Water can be source of power either directly as water wheel for milling or conservation into electric power.

However excess water on the farm can cause the following problems;

- Soil erosion caused by running water taking away soil.
- Water logging and flooding due to inadequate drainage.
- As a reservoir agent of diseases (e.g. bilharzia) or their vectors (e.g. Mosquitoes carrying malaria)

Sources of farm water

- Surface water; this is the immediate result of precipitation (rain, hail or snow). The limitation of this source is that it is not often available at the place when it is needed
- Underground water; water enters through the soil where it may be held as soil moisture. It may continue to percolate deeper to the ground water supply, soil water is readily available for plants.

Treatment of water

- (i) **Sedimentation:** - Water is allowed to pass through large quantities of sand to filter out the sediment before it is used.
- (ii) **Addition of chlorine:** - Chlorine in form of hypochlorite can be added to kill pathogens.
- (iii) **Copper sulphate** can be added to check liver fluke infection in livestock drinking water.

Maintenance of farm water supplies

- (i) All ponds, springs and wells should be lined with concrete or brick wall to avoid contamination.
- (ii) Urine and all other animal waste should be well disposed to avoid contact with water bodies
- (iii) All water sources should be kept free from pesticide, herbicides or any other farm chemicals.
- (iv) All open water reservoirs such as ponds should be well cleared of the surrounding vegetation.
- (v) All water pumps should be kept in good working condition e.g. should be lubricated and fueled.
- (vi) There should be regular cleaning operation of all the water storage facilities.
- (vii) Any cracks in water systems like pipes, ponds, wells and dams should be checked and repaired.
- (viii) There should be proper sewage disposal in all farm units.

FARM MACHINERY

Agricultural mechanization is the application of engineering principles and technology in agricultural production, storage, and processing on the farm or is the use of tools,

implements and machinery to improve the productivity of farm labor and of land. Agricultural mechanization includes development, application and management of all mechanical aids for field production, water handling, storage and processing. There fore, Farm mechanization is the use of machines to perform farm jobs.

Advantages (benefits) of farm mechanization

- It leads to timeliness in farm operations e.g. planting, weeding and harvesting.
- It improves on efficiency of farm operations.
- It increases on the farm out put per human hour
- It makes work easy and interesting to farmers.
- It discourages land fragmentation.
- There s an improvement in the quality of the product.
- It facilitates easy control of pests and diseases on the farm.
- It increases on the area under cultivation and new land can be developed for agricultural production which facilitates increased production with the adoption of other improved technologies such as improved seeds, use of fertilizers, agro-processing etc.
- Reduces drudgery in farm work
- Preservation and processing of farm produce results in reduced spoilage and loss of produce (pre and post harvest losses)
- Agricultural production throughout the year is possible with the adoption of technologies such as irrigation, improved seeds, fertilizers, processing etc.
- Provides increased opportunity for employment
- Improves dignity and prosperity of farmers

Disadvantages of farm mechanization

- (i) The initial cost of purchasing the machinery is high.
- (ii) The operation of the machines requires technical skill and knowledge.
- (iii) Much acreage of land is exposed to erosion.
- (iv) It leads to loss of job opportunities (unemployment)
- (v) Mechanization is only possible for large scale farmers.
- (vi) It is only suitable where the landscape is flat.
- (vii) It necessitates mechanizing all the farm jobs yet its so difficult.
- (viii) Maintenance of the machines is very expensive.

Factors hindering the adoption of mechanization in E. Africa

1. Spare parts for the machines are not readily available
2. The hilly topography for E. African regions is unfavorable for mechanization.
3. There s lack of demonstration centers for use of the machines.
4. The thick vegetation hinders the use of machines especially the ploughs.
5. Land fragmentation. It is difficult and uneconomical to use machines on small farms
6. High cost of machinery/low purchasing power of most small scale farmers
7. Lack of well trained operators and mechanics for agricultural machinery

8. Lack of suitable machinery packages for main agricultural operations. The most mechanized operation is tillage and transport to a limited extent. Other operations like planting, weeding and harvesting are rarely mechanized in small holder farming. This limits the benefits of mechanization
9. The pattern of agriculture e.g. subsistence farming
10. Lack of adequate research and absence of incentives for indigenous design and manufacture of farm equipment
11. Importation of tools, equipment and machinery of poor quality which results in poor performance
12. Acquired labor is easily available
13. Lack of repair and servicing facilities for machines
14. Lack of coordination between organizations and manufacturers

Examples of machines used on the farm include tractors, motorized sprayers, mooners, milking machines, incubators, water pumps, chain saws, planters, weeders etc.

Need for Farm Mechanization

- A large number of female workers and children work on the farm unwillingly because of shortage of labor. The increase in rural to urban migration, increase in non-farm employment opportunities, HIV/AIDS, and malaria epidemic have all contributed to labor shortage
- The population is increasing at an alarming rate. Currently the growth rate in Uganda stands at 3.2% per annum implying more food production is needed to meet the needs of the ever growing population
- Timely farm operations are becoming crucial in view of the rainy season being shorter in some parts of the country. Therefore to benefit from the rains, field operations must be accomplished in the shortest possible time.
- Proper utilization of basic inputs like water, seeds, fertilizers etc.
- Preparation of suitable seedbeds
- Certain operations are rather difficult to be performed by animal or human power e.g. deep ploughing in case of deep rooted crops, killing the pernicious weeds; leveling of un-even land, land reclamation, insecticide application during epidemic seasons

How to promote Agricultural Mechanization

- Adequate infrastructure facilities such as roads, electricity etc.
- strengthen education and extension programs to keep farmers updated on various aspects of engineering to agriculture
- Awareness by the policy makers with the understanding of the crucial role of agricultural mechanization in modernizing agriculture
- Providing subsidies on farm inputs through governmental programs
- Promoting continued research programs aimed at designing appropriate machines for farm production and manufacture
- Setting up demonstration/model farms
- Make loans accessible to farmer groups with low interest rates
- Custom hiring system should be encouraged in rural areas
- Start adequate centers for evaluation and repair of power units and equipment

Precautions taken when handling farm machines

- (i) Operation of all machines should be in accordance with manufacturers instructions in the manual.
- (ii) The right machine should be used for the specified piece of work e.g. harrows and planters shouldn't be used for primary tillage.
- (iii) Machines should be well serviced and oiled before work.
- (iv) All repairs should be done by qualified experienced personnel.
- (v) Motorized machines shouldn't be used for primary tillage.
- (vi) Machine should be well serviced and oiled by work.
- (vii) All repairs should be done by qualified experienced personal.
- (viii) Motorized machines shouldn't be operated by children below 18 years.
- (ix) Avoid working for very long hours as fatigue can result in loss of service leading to accidents.
- (x) Avoid taking alcohol or narcotic before operating machines.
- (xi) Avoid putting on torn clothes, those with turn ups and loose clothing as these can be entangled in the moving parts
- (xii) Engines for all motorized machine should be switched off when not in use.
- (xiii) Children should be in a distance of about 60m away when motorized machines like tractors are in operation
- (xiv) All machines should be kept in special places such as garage or machine stores.

SOURCES OF FARM POWER

Farm power refers to the energy needed to do work on the farm.

These include;

1. Human laborers
2. Animals
3. Wind
4. Electricity
5. Engines
6. Solar energy

1. Human power



Human laborers are used to accomplish farm jobs e.g. land clearing, weeding, milking, harvesting, transportation etc.

Advantages

- Its very cheap
- It does not need physical supervision or operation.
- It is the most convenient for small scale farmers.

Disadvantages

- Human efficiency declines with working hours and fatigue.
- It cannot cope with large acreages.
- It is influenced by health condition.
- Malice and shikes are always part of human labour.

2. Animal power



It can be used in cultivation and transportation

Advantages

- Its operation does not require high skilled labour.
- It can be used in transportation of heavier loads.
- Animals can operate well in areas where land is fragmented.
- Animal drawn implements are quite cheap to purchase and maintain.

Disadvantages

- It requires a big block of land for grazing livestock.
- They are affected by long working hours/ fatigue.
- Their efficiency is affected by health.
- Animals cannot really cope with a very large acreage of land.

3. Wind power



It is used to perform jobs like winnowing grain e.g. sorghum, millet, maize etc. it can also be used for pun water, run by wind mills.

Advantages

- It's free.
- No special labour skill is required.

Disadvantages

- Its availability, strength and direction are very unpredictable.
- The cost of windmills and accessories is high.

4. Electricity

This is used to run machines e.g. incubators, mill machines, processing mills. It is also used for lighting farm and also for fencing.

Advantages

- It is very efficient.
- It is quite easy to maintain.

Disadvantages

- The initial cost of installation is high.
- There's no work done in event of power failure.

5. Engine power

Its power supplied by motorized machines e.g. tractors, chain saws, mowers, sprayers.

Advantages

- It saves time and labour.
- It increases efficiency and precision of timing farm operations.
- Engine power is not affected by long working hours and fatigue.
- It copes up with large land acreage.

Disadvantages

- It requires skilled man power to operate.
- The purchase/ maintenance of machines is expensive.
- It may create unemployment.
- It is only convenient for large scale farmers.

6. Solar power

It can replace electricity. It is free of charge but the cost of installation is high.

TILLAGE IMPLEMENTS

Tillage is the preparation of soil for planting. This is done by manipulation of the soil with implements for loosening the surface crust bringing about conditions favorable for the germination of seeds and the growth of crops.

The main objectives are:

- The production of a suitable tilth or soil structure.
- The control of soil moisture
- Destruction of weeds and pests
- The clearing of rubbish and incorporating of the manure and fertilizers.

Importance of tillage on soil properties.

- Bulk density: When soil is loosened, the soil volume increases without any effect on weight.
- Pore space: Tillage increases the pore spaces
- Soil water: Tillage improves soil water in different ways depending on soil porosity, soil depth and roughness.
- Soil temperature: tillage creates up to soil temperature for seed germination and establishment.
- It improves soil structure.

Primary tillage

This is the initial opening up of land by breaking up the soil after a previous crop or on virgin land (land that was not under cultivation)

Primary cultivation is necessary because:

- It helps in improving soil structure so as to facilitate water infiltration, aeration, and plant root development.

- It enables burying of crop residues of the previous season which rot and form organic manure.
- Destruction of weeds and pests

Primary Tillage implements

These are items of equipment which initially, till the land to a depth of 20-22cm.

The essential features of ploughing is separating the layer of soil from the subsoil which is inverted so burying any vegetation and bringing a layer of soil from below to the surface.

Methods of primary tillage include: Hand digging, ox-ploughing and mould board ploughing.

Primary tillage implements include Disc ploughs, Mould board (Ox-ploughs chisel ploughs, rotavators and sub soilers). The commonest are **Disc ploughs** and **Mould board ploughs**.

THE DISC PLOUGH

Components of the Disc plough.

- (i) **The main beam:** - It provides support for all other parts. It also adds weight for better penetration of the plough.

- (ii) **Disc hanger (standard):-** It supports the disc blade to the main beam. It is also used to adjust the disc angle.
- (iii) **Scraper:-** It cleans off sticky soil from the disc blade. It also helps in turning the furrow slice.
- (iv) **The disc blades:-** These are used to cut, turn and invert furrow slices.
- (v) **Shank:-** it supports the scraper to the main beam.
- (vi) **Furrow wheel:-** It controls the depth of ploughing. It also stabilizes the plough during cultivation.
- (vii) **Hub/ roller bearing:-** It facilitates rotary motion of the disc blade.
- (viii) **Top link bracket:-** This and the cross shaft are used to mount the plough to the tractor.
- (ix) **Furrow wheel spindle:-** It has 3 points used in setting the depth of the plough.

Advantages of using a disc plough

- (i) Due to its rolling, it rides over obstruction such as tree stumps and stones without damage.
- (ii) It can be used in dry and hard areas which are too difficult for the mouldboard plough.
- (iii) It works well in both light and heavy sticky soils.
- (iv) It has a comparatively lower maintenance cost than M.B.P.
- (v) It can be used when deep ploughing is required.
- (vi) It can be used in marshy water logged areas.
- (vii) It covers a bigger acreage in a short period of time.
- (viii) The disc plough cannot be easily damaged.

Disadvantages of using a disc plough

- (i) The soil conversion is poor. The plough doesn't bury trash well.
- (ii) It requires more skill to operate compared with the M.B.P.
- (iii) The initial cost of its purchase is very high.
- (iv) It leaves the field in a very rough state.
- (v) It is heavier and requires more power to pull.

Adjustments done on a disc plough

- (a) The cutting angle:- it can be adjusted 35° to 50°. It is done by pivoting the
- (b) Ploughing depth:- done by adjusting the height of the depth wheel or adjusting the hydraulic system.

Care and maintenance of the disc plough

1. Lubricate the bearings regularly as instructed in the manufacturer's manual.

2. Regularly check and tighten loose bolts and nuts.
3. Clean the disc blades every after work.
4. Repair or replace broken parts.
5. Disc blades should be oiled or greased during resting season.

THE OX MOULD BOARD PLOUGH

It is an ox drawn implement.

Components of the mould board plough



- (i) **Main beam:** - It is where all other parts are attached.
- (ii) **Hake:** - it is a screw used for adjustment of depth rod.
- (iii) **Depth rod:** - It adjusts the depth and width of ploughing.
- (iv) **Depth wheel (hand wheel):**- It regulates the dept of ploughing and also encourages easy movement during cultivation.
- (v) **Frog:** - It provides attachment for mould board, land side and share.
- (vi) **Share:** - It cuts furrow slice and passes it to the mould board.
- (vii) **Mould board:**- For inverting
- (viii) **Land side:** - Praises against the furrow wall, separating the un ploughed land. It also stabilizes the plough.
- (ix) **Pitch (down suction):**- Determines the ploughing angle and facilitates adequate penetration of the plough.
- (x) **U Bolt:** - Provides support for the draft rod to the main beam.
- (xi) **Draft rod (draw bar):**- It s where the chain is attached when the implement is drawn (pulled).

Advantages of using the ox mould board plough.

- (i) It completely turns the furrow slice thus covering the surface vegetation properly.
- (ii) It provides a relatively good and clean seed bed.
- (iii) It operates at a uniform depth if required.
- (iv) It can work well in a rugged terrain, which is not possible with a disc plough.
- (v) The initial cost of purchase is quite low.
- (vi) Its operation does not need high technical skill.
- (vii) It s quite easier to repair.

Disadvantages of the ox mould board plough

- (i) It can easily be damaged by obstacles like stones, stumps etc.
- (ii) It may encourage hard pan formation.
- (iii) It cannot work in dry hard areas.
- (iv) It has a higher maintenance cost than the disc plough.
- (v) Much more effort is required in pulling.

Care and maintenance of the mould board plough

1. Sharpen and tighten the shares before going to the field.
2. Lubricate all the moving parts such as the bearings of the land wheel.
3. Clean up the implement after every work by removing sticky soils.
4. All damaged parts should be replaced as soon as they are identified.

Factors that can lead to success of ox cultivation in some parts like eastern Uganda

- (i) There are large herds of cattle in these areas.
- (ii) There is plenty of land for pasture grazing.
- (iii) The soils are sandy and thus light for the animals to draw the plough without difficulty.
- (iv) The vegetation is composed of short grass and light bushes which can be easily ploughed.
- (v) Eastern Uganda is relatively flat so animals don't get strained like when they are ploughing up hill.
- (vi) Ox implements have locally been developed to suit effective operation by animals.
- (vii) The maintenance cost of the animals and the implements is affordable compared to that of a tractor.

Limitations of ox cultivation

- 1. Cattle rustling has had a great impact on these parts of Uganda.
- 2. Oxen usually get tired when over worked so they have a short working period.
- 3. The efficiency of their work is determined by their health state.
- 4. They are slow in cultivation and usually cover a small acreage of land.
- 5. Ox cultivation is only limited to land preparation, and seeding. They can't carry out spraying and harvesting.
- 6. It is only possible where there is plenty of land and pasture for cattle grazing.

Secondary tillage

Secondary tillage refers to the tillage operations that are carried out after primary tillage. It involves turning and braking of soil clods to ensure a fine tilth and suitable conditions for planting. It is usually done after 3-4 weeks from primary cultivation. This period enables the trash to decompose properly.

Importance of secondary cultivation.

- It turns the soil bringing rotten organic matter near the surface for plant use.
- Soil borne pests are exposed to natural predators and scorching sun.
- Aims at leveling of the land to achieve a uniform depth for planting.
- Incorporation of organic matter and fertilizers into the soil.
- It breaks big clods to the required tilth for proper germination of seeds and root penetration.

Factors that determine the number of secondary operations

- The type of crop to be established ; Relatively large seeds(maize ,Cotton or ground nuts) require a relatively rough seed bed whiles smaller seeds(wheat) require a fine seed bed hence more number of tillage operations.
- The nature of soil clods: If the original clods are very big, it may require several tillage operations than in light soils such as sand and loam.
- Susceptibility of soil erosion: If there is likelihood of soil erosion taking place in a given area the number of cultivation is low.

- Availability of trash: When there much trash, for instance in a garden where sugar cane has been harvested, it will require more operations. This will ensure that trash has been fully decomposed and incorporated into the soil.
- Type of weeds in the garden: Annual weeds when ploughed in the soil easily decay and may require one secondary operation. perennial weeds such as couch grass require more secondary operations to remove stolon and rhizomes

Secondary Tillage implements

These implements are used in the cultivation that follows the initial ploughing. These implements are usually light and operates at a shallower depth higher speed than primary tillage implements.

The cultivation here involves harrowing of the soil for the seedbed preparation, rigging and weeding.

The tools and implements used here include: disc harrow, a rotovator, rollers and ridgers.

A disc harrow;

It has a gang of discs set in such away to cut soil clods and incorporate trash into the soil. The first set of gang may be toothed so as to cut the trash into small pieces. The second gang has smooth blades that turn the small clods to make a fine seedbed. This is a simple mechanism to carry out secondary cultivation.

The tilth obtained depends on the crop to be grown. Finer tilth is recommended for crops with small seeds especially grains. Plantation crops and maize require rough tilth.

A rotovator:

This is used to break down soil clods to small sizes. It is effective in cutting trash and it with soil. It is also used for mixing inorganic fertilizers with soils.

This implement draws power from the Power take off on a tractor. The power is tapped by means of shafts which are connected to the rotor. The rotor has many L-shaped blades. These blades are made to rotate at high speed. They cut and throw soil up wards. The hood covers the blades so soil thrown up is smashed on hood which further breaks the soil into fine particles. The degree of pulverization depends on the adjustment between the rotor and the hood. If it is close then the clods will be broken to very fine particles.

Others include:

- spring tinned harrow
- Zigzag harrow
- Spike toothed harrow.

Choice of tools and implements

- Soil condition
Dry heavy soil requires heavy implements like a disc plough while as light soils is easily cultivated by use of a hand hoe or ox-plough, especially in areas of Teso.
- Soil type
Some soils especially sand and sandy loams, can easily be cultivated by hand or o-ploughs. Other soils like clay or clay loams are very sticky and therefore, require a disc plough.

- **Topography**
In areas which are very hilly, disc ploughs cannot be used since tractor movement will be difficult. So in such areas, hand hoes and Ox-ploughs are used whereas on flat land Ox-ploughs, hand hoes and disc ploughs can be used
- **Nature vegetation :**
In areas with tall vegetation, Ox-cultivation and use of hand hoe is limited. It is the disc ploughs that are prominent. Disc ploughs can be used in such areas because they can easily roll over obstacles and trash does not block.
- **Availability of capital:**
Cost of purchasing or hiring tractor services are very high so peasant farmers cannot afford. This explains why hand hoe are still dominant in farming Operations.
- **Availability of labour:**
In some areas, hand hoe are used because of available human labour and Ox-plough is used in areas where Oxen and donkeys are available and trained. In some areas where there are tractors and farmers can afford tractor services, tractor trailed implements are used. This is so because tractors require skilled labour.
- **Land tenure:**
In areas where land is fragmented, it is difficult to use machines such as tractors. Hand hoes are convenient. Farmers with large pieces of land can use tractors and animal trailed implements.
- **Conservatism;**
Some farmers are not willing to change from traditional tools for instance; some do not like use of tractor implements on the basis that they spoil the soil. They prefer using hand hoes and in many situations they are not sure of the results of using heavy machines.

Tertiary tillage

These are subsequent operations following secondary cultivation.

It includes:

- **Ridging**
This is done by use of special implements called ridgers.
It is practice of heaping soil in a continuous line to create a mound into which crops (Irish potatoes and sweet potatoes) are planted
- **Rolling;** it is the compaction of the loose and fine soils using rollers and is commonly applied in growing some seeded crops. This is done to establish firm ground. After sowing, tractor trailed roller is passed over the garden to cover seeds uniformly and ensure uniform germination, common in pasture establishment. Some people pass over a big branch to effectively cover small seeded crops. In situations where the soil particles are too loose, rolling is used to reduce the dangers caused by agents of erosion.

- **Leveling:**
This is the process of making seed bed surface even and flat. It is a common practice for small seed crops. In a seed bed, leveling is done by use of a rake. This helps to remove big soil clods, mix organic manure and to make planting of seeds easy.
- **Subsoiling:** It is a practice of breaking hard pans in sub soil. This is achieved when soil is ploughed at a deeper depth than the normal depth of 30-60cm. This is done by use of subsoilers. Subsoilers help to break the hard pans developed in soil layers due to continuous cultivation at the same depth. Hard pans prevent water infiltration, aeration, root penetration and development. As one carries out subsoiling, the soil conditions such as aeration and water infiltration are improved. Subsoilers may also be used to open up water channels for drainage.

Minimum tillage

This is when the seed bed is prepared with little disturbance of the soil to conserve soil and water. It is recommended that only those areas to be planted should be disturbed. If a large area is cultivated, soil erosion will be high. The following practices may be applied in order to achieve minimum tillage

- Use of herbicides to kill weeds in the garden in an attempt to prepare a seedbed.
- Cultivate only a small strip where to put the planting materials and leave the garden undisturbed.
- Mulch the area to suppress weed growth.

Importance of minimum tillage:

- It reduces surface run off, thus controlling soil erosion.
- It reduces the barrenness of soil surface such that wind erosion is checked.
- Increases water infiltration which is effective in water conservation
- Reduces cost of production since only a small area is cultivated.
- It maintains soil structure.

Disadvantages of minimum tillage.

- It may lead to soil compaction since most is not disturbed.
- Heavy chemicals may pollute the environment

FARM TRACTORS

The tractor provides power for many activities, both mobile and stationary.

All tractors have internal source of power (combustion of fuel occurs inside the engine cylinder)

The chemical fuel or energy is converted into heat energy by burning of fuel and air mixture in the cylinder of the engine. The heated gas creates high pressure which causes the piston to move downwards. The piston movement is connected to the rotation of the crank shaft and connecting rod.

. Some of the power is generated in engine and is lost before use.

Power generated by ICE is called indicated horse power of tractor.

Uses of tractors

- (a) Used in field operations such as cultivation, planting and spraying.
- (b) Used in transportation of farm produce.
- (c) They are used to run grinding mills and lawn movers and water pumps.

The parts that transmit power in a tractor

- 1. **The propeller shaft:** - It connects the gear to the differential, making the tractor to move.
- 2. **The P.T.O (Power take off) shaft:** - It is located at the back and rotates at the same revolution with crank shaft. It can be used in driving machines like mowers.
- 3. **The hydraulic system:** - It has a hydraulic shaft and is attached to the 3 point linkage. It is used in lifting implements.
- 4. **Draw bar:** - Its used in trailing tractor drawn implements e.g. ploughs and trailers.

Parts on the tractor to be checked before going for work

- 1. **Fuel:-** The tank should be filled with fuel before the day starts
- 2. **Engine oil:** - Oil level should be checked with a dip stick. It should be changed weekly.
- 3. **Battery:** - The level of electrolyte should be topped with clean distilled water if it is too low.
- 4. **Radiator:** - Should be filled with clean water.
- 5. **Air cleaner:** - Pre cleaner and salts should be cleaned. The dirty oil should be removed and replaced with clean oil.
- 6. **Nuts and bolts:** - These should be tightened well if they are loose.
- 7. **Fan belt:** - It should be checked and adjusted to the right tension.
- 8. **Tyre pressure:-**It should be pumped up if it is low.
- 9. **Gear box and differential oil:** - It should be checked and added when servicing.

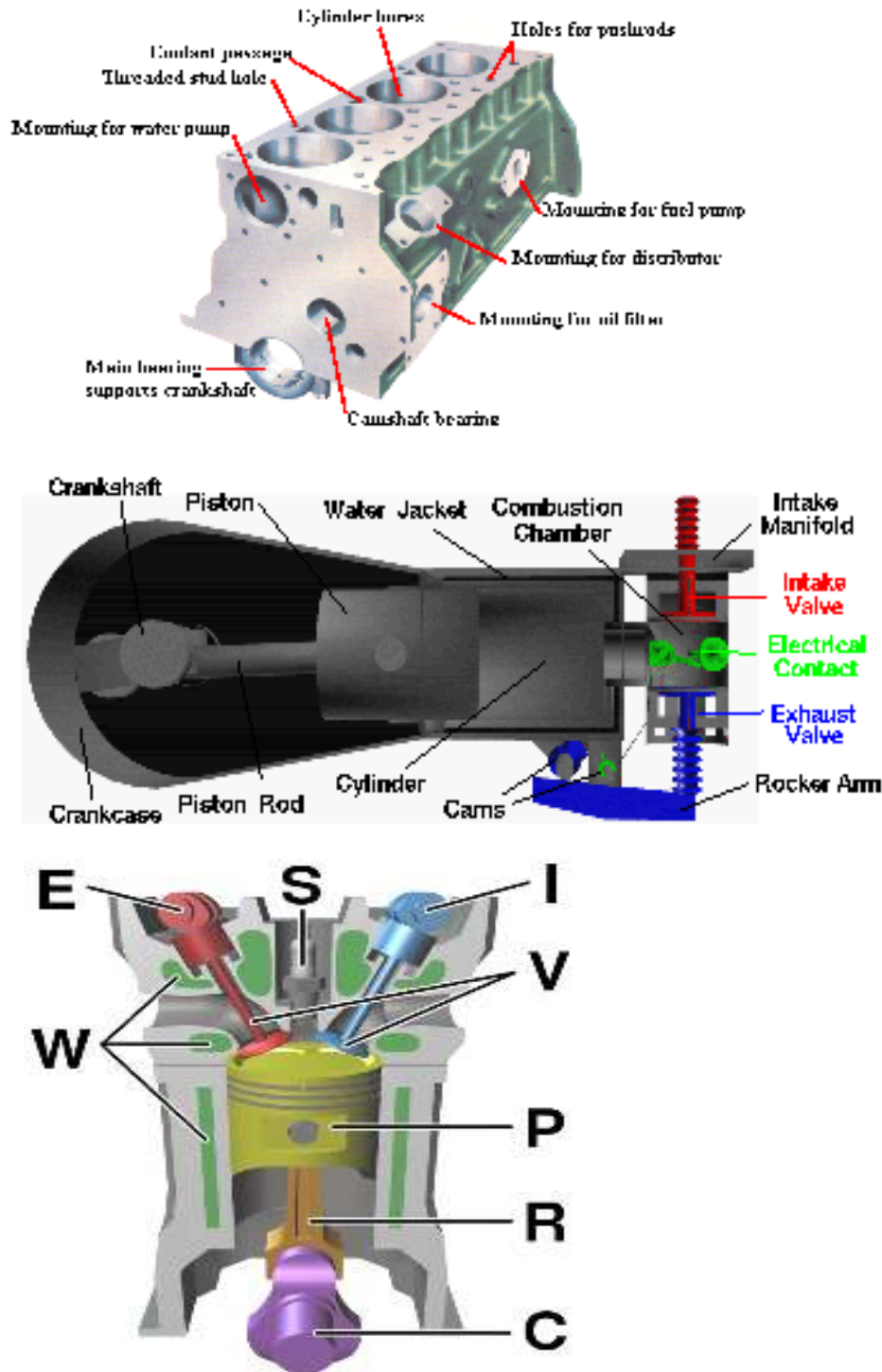
Importance of the above checks

- (i) It avoids loss of nuts, bolts and pins that could be loose.
- (ii) It avoids time wastage when a fault is discovered during operation.
- (iii) It avoids accidents to the personnel.
- (iv) It puts the tractor in an efficient operative condition.
- (v) It prevents unnecessary tear and wear on the tractor.

FARM ENGINES

Engines are commonly found on tractors, grinding mills, and water pumps. They are all classified as I.C.Es; Internal Combustion Engines because their principle of power production is based on fuel combustion inside cylinder chambers.

Major parts of an internal combustion engine.



1. **Cylinder:** - It is an air tight chamber in which combustion of fuel air mixture takes place. The higher the number of cylinders an engine has the more the power it **produces**. Cylinders are tubes or sleeves that serve as a bearing for pistons to move up and down inside them. They have highly polished internal

surfaces to provide a close fit between piston and cylinder to prevent leakage of gasses.

2. **Cylinder head:** - It seals the top of the cylinder, houses valves, sparks plugs, diesel injectors etc.
3. **Engine block:** - It is the main housing for cylinders. It provides space for piston and piston rod to operate in and produce power. Its construction depends on type of work done by the engine, total power produced by an engine, valve arrangement, method of cooling, and compression ratio. It provides passage for cooling materials.
4. **Piston:-** It moves up and down in the cylinder chamber and compresses air-fuel mixture. It transmits power produced in the cylinder to the crank shaft. It helps in lubrication by scooping oil out of the sump and splashing it upwards, it helps to expel exhaust gasses from the cylinders etc.
5. **Piston clearance;** This is a space left between the piston and the cylinder wall
6. **Piston rings:-**
 - (i) **Compression rings:-** these assist in retention of compression done by the piston.
 - (ii) **Oil rings:-** they help in oil retention and reduction of heat consumption.
7. **Gudgeon pin:** - It provides attachment of the piston rod to the piston.
8. **Connecting rod:** - It connects the piston to crank shaft and also transmits the rotary motion of the piston to crank shaft.
9. **Crank shaft:** - It rotates and keeps the piston moving up and down. It functionally transmits power from the engine to all other moving parts such as fly wheel, water pumps etc.
10. **Cam shaft:** - It is a shaft fitted with cams to operate opening and closure of the valves.
11. **Valves:** - These allow entry and exit of fuel and production of combustion respectively.
12. **Crank case:** - It accommodates the crank shaft. It is sealed at the bottom by the sump. This acts as a reservoir for lubricating oil in the engine.
13. **Fly wheel:** - It is a heavy wheel connected to the crank shaft. It stores momentum between strokes, smoothes movement of crankshaft and transmits power to the clutch.
14. **Gasket:** - It is an asbestos sheet between cylinder head and engine block which forms an air tight seal for cylinders.

Terminologies associated with engine operation

1. **Top dead centre (T.D.C):-** It is the maximum point reached by the piston on its upward movement in the cylinder.
2. **Bottom dead centre (B.D.C):-** It is the maximum point reached by the piston on its downward movement in the cylinder.
3. **Stroke:-** It is the movement of the piston from T.D.C to B.D.C or vice versa.

- 4. Firing order:** - It is the order or sequence in which ignition is experienced in the cylinders.

Examples

- 3 cylinder engine - its 1, 2, 3
- 4 cylinder engine:- its 1, 3, 4, 2, or 1, 3, 2, 4
- 6 cylinder engine:- 1, 5, 3, 6, 2, 4, or 1, 4, 2, 6, 3, 5

- 5. Compression ratio:-** It is the ratio of vol of cylinder at B.D.C to that at T.D.C.

- 6. Air fuel ratio:-** It is the ratio of vol of air to vol of fuel combined.

Differences between petrol and diesel engines

Petrol (S.I) Engines	Diesel (C.I) Engines.
- Uses petrol as fuel	- Uses diesel as fuel.
- Fuel is ignited by an electric spark,	- Fuel is ignited by compression.
- It has a carburetor.	- It has no carburetors.
- Has a low compression ratio (8:1)	Has a high compression ratio (6:1)
- Produces less smoke.	- Produces more smoke.
- Quite cheap to purchase.	- Very expensive to purchase.
- Uses more fuel per unit area.	- Uses less fuel per unit area.
- At induction, both air and fuel enter cylinder for compression.	- Only air enters cylinder for compression.
- Light in weight and produces less power.	- Heavy in weight and produces more power.

NB; S.I= Spark Ignition,

C.I= Compression Ignition.

The 2 stroke engines

2 Stroke engines are commonly found on small farm machines such as lawn mowers, land masters, motorized sprayers, and chain saws and also on motor cycles. These engines do not have valves but they have ports. The events of induction/ compression, ignition and exhaust are completed in 2 strokes.

1. Induction and compression stroke

The piston moves up ward and covers the exhaust and transfer ports hence entrapping a fresh fuel air mixture and compressing it.

Towards its upward climax the piston uncovers the inlet port and a fresh mixture is sucked into the crank case.

Power (ignition) and exhaust stroke

At the end of the compression stroke, a spark is produced and burns the compressed air fuel mixture.

The explosion and expansion of the burnt gases force the piston down ward.

In its course the inlet port and uncovers both exhaust and transfer ports hence expelling the burnt gases and expelling the burnt gases and allowing for transfer of the fresh mixture from crank case to the compression chamber.

Advantages of 2 stroke engines

- (i) They are cheap to buy and easy to maintain.
- (ii) They are lighter in weight and portable.
- (iii) They are not complex in construction.

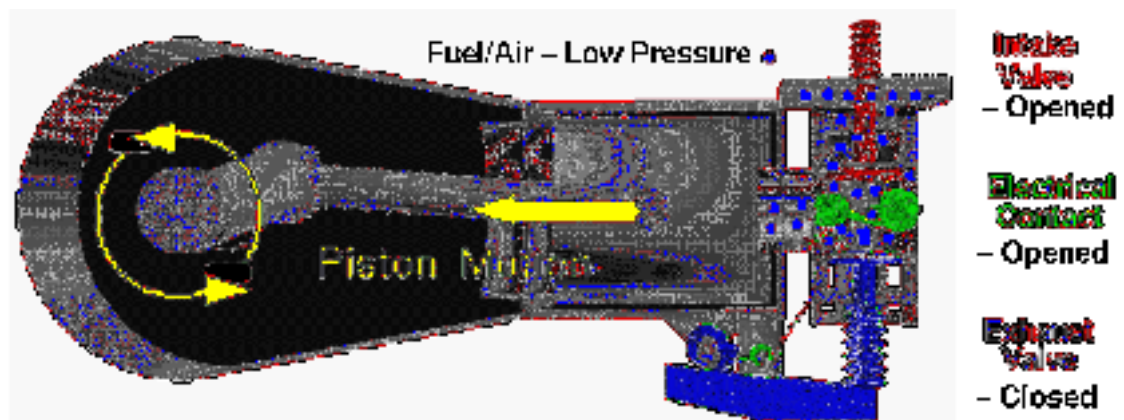
Disadvantages

- (i) They are inefficient in fuel utilization.
- (ii) Lubrication and cooling is not effective.
- (iii) They are usually air cooled and this limits their size.
- (iv) Their speed and corresponding power are uncontrollable.

The 4-stroke cycle in a petrol engine

The cycle of events is completed in 4 strokes of the piston but the fuel used is petrol.

1. Induction (inlet) stroke.

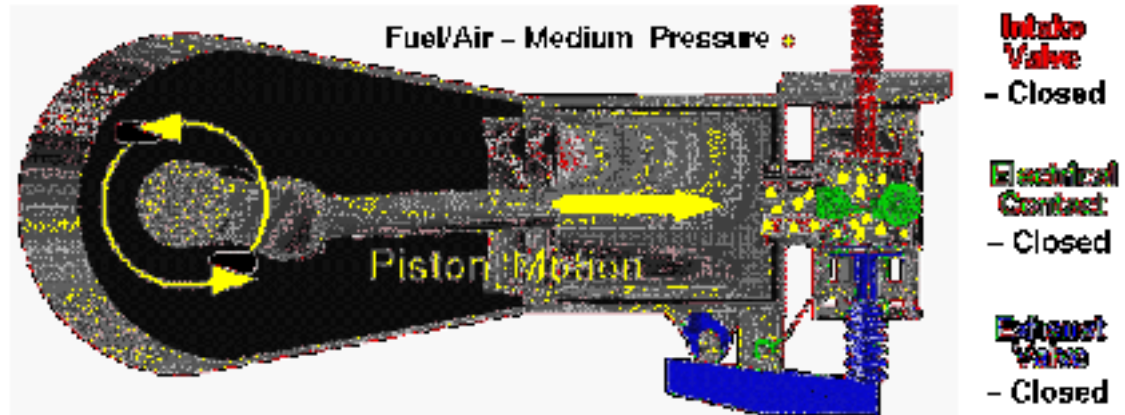


As the piston moves down ward, exhaust valve closes and inlet valve opens.

The fuel air mixture is admitted into the cylinder through the inlet valve.

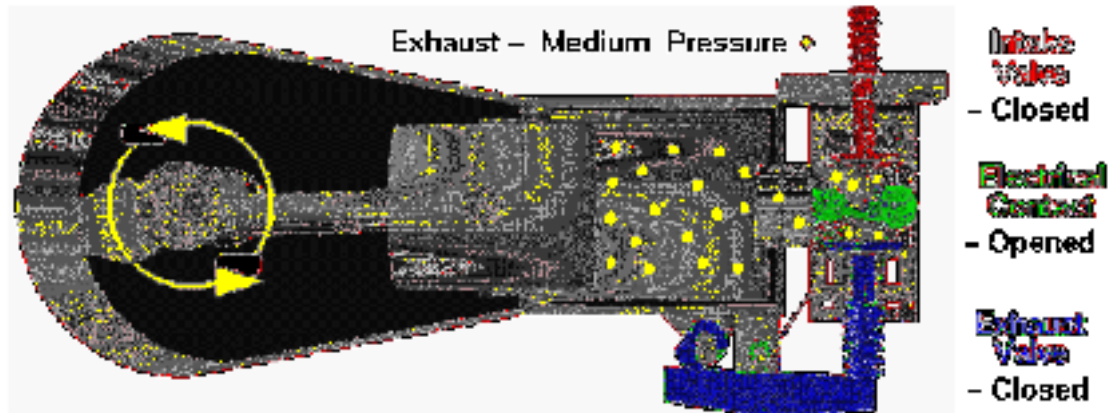
The stroke ends when the piston reaches the B.D.C.

2. Compression stroke



As piston moves upward, both valves are closed. The fuel mixture entrapped in the cylinder is compressed and its temperature raised.

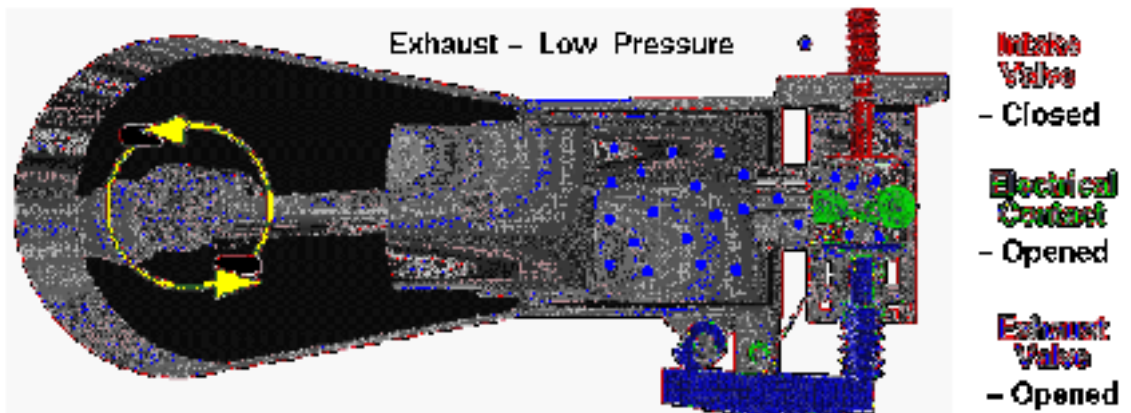
3. Ignition (power) stroke



The plug provides a spark that ignites the hot compressed mixture.

The explosion and expansion of the burnt gases force the piston downward.

4. Exhaust stroke



The piston moves upward and exhausts valve opens to expel the burnt gases.

The purpose of the exhaust stroke is to clear the cylinder of the spent exhaust in preparation for another ignition cycle. As the exhaust stroke begins, the cylinder and combustion chamber are full of exhaust products at low pressure (colored blue on the figure above.) Because the exhaust valve is open, the exhaust gas is pushed past the valve and exits the engine. The intake valve is closed and the electrical contact is open during this movement of the piston.

The 4 stroke cycle in a diesel engine.

1. **Induction:** - Only air is drawn into the cylinder.
2. **Compression stroke:** - Only air is compressed in the cylinder to a very high temperature.
3. **Ignition (power) stroke:** - Jets of diesel is injected into the hot compressed air and the resultant explosion and expansion of the gases force the piston downwards.
4. **Exhaust stroke:** - Exhaust valve opens and burnt gases are expelled.

MAJOR SYSTEMS IN TRACTOR ENGINES

1. THE FUEL SYSTEM

It functionally helps to purify and deliver fuel from the tank to the cylinders.

Components of the fuel system (diesel engine)

1. **Fuel (diesel) tank:** - It stores fuel and protects from contamination.
2. **Sediment bowl:** - It removes large particles and other similar impurities from the fuel.
3. **Lift pump:** - This continuously pumps the fuel and also eliminates any air bubbles in the system.
4. **Fuel filter:** - It removes all solid impurities from the fuel by straining it.
5. **Injector pump:** - It subjects the fuel to very high pressure. It also atomizes the fuel and sends it to the cylinder through the injector.
6. **Fuel injectors:** - These introduce the fuel into cylinders as a fine spray.

The fuel system of a petrol engine

Fuel flows from the tank, through sediment bowl, fuel pump, fuel filters then it comes to the carburetor.

The carburetor functionally helps in mixing petrol and air in the right proportion before sending the mixture to the cylinder.

Components of the carburetor.

Action of the carburetor

Fuel from the tank reaches the carburetor and goes into the float chamber. The chamber contains a valve which maintains a constant fuel level. When the fuel is full, the float valve closes and cuts off the fuel supply, till the level goes down, then the supply is resumed.

From the float chamber, fuel is delivered by a jet discharge tube to a narrow passage called the venturi. At the venturi, the fuel emerges at high pressure and is mixed with clean air from the air cleaner to form a fuel – air mix ratio of 1:15. The mixture (in vapour form) is then sent to the cylinder through the inlet valve.

NOTE:- As the mixture leaves the venturi it passes through the throttle valve (accelerator), whose function is to regulate the amount of fuel – air mixture entering the engine. By regulating this, the throttle therefore controls the running speed of the engine.

Maintenance of the fuel system

- **Fuel tank:** - This should be kept clean and full of clean fuel.
- **Sediment bowl:** - It should be cleaned as often as possible.
- Pipe connections
- **Fuel filter:** - Element should be replaced whenever necessary.
- **Injector pump:** - It is found only on diesel engines. It should be kept clean and pipe connections tight.
- **Carburetor:** - For only petrol engines. It should be regularly cleaned; the nuts and screws should be kept tight.

AIR SUPPLY

Air from the atmosphere is cleaned and purified by the air cleaner before its allowed into the engine. If it is not cleaned, dust and other foreign impurities would mix with the fuel and damage the engine.

The air cleaner

Two types of air cleaner; namely

- (a) The wet (oil bath) air cleaner
- (b) The dry element air cleaner

Structure and parts of the oil bath air cleaner

Action

Air from the atmosphere enters the pre-cleaner through the inlet louvers. Here, it is rapidly swirled, through out the large dust and grit particles through slot on top of the pre-cleaner.

The air then fallows the central pipe, carrying the lighter material, down to the oil bath. Most of this material gets entrapped in the oil.

As it reverses its direction, the air passes through the filter element (wire mesh) which is wetted with an oil film. This is where the remaining tiny dust particles are stuck. The air then leaves the cleaner to the engine when it is completely clean.

(b) The dry air cleaner:- This has got a disposable element. As air passes through the element, all dust and grit particles are entrapped, leaving clean and dust free air to enter the engine.

Maintenance of the air cleaner.

1. The oil bath should be checked weakly and should be refilled with oil to the recommended mark.
2. The filter element should be frequently cleaned with paraffin and after drying, it should be dipped in clean oil to cause formation of the film.
3. The filter element should always be replaced with a new one once it becomes old and inefficient.
4. The injection slots on top of the pre cleaner should be cleaned of any particles stuck there in.
5. If the machine is working in very dusty conditions, the oil bath should be checked daily.

THE COOLING SYSTEM

It functionally helps in cooling the engine.

Effects of heat in the engine

1. It leads to expansion and distortion of shape of the engine parts. This may lead to gas leakage, loss of power or even cracking of cylinders.
2. It leads to high fuel consumption.
3. It can cause pre-ignition i.e. over heating of engine parts which ignites the fuel mixture before production of the spark.
4. It leads to dilution and contamination of oil.

Types of cooling system

1. Air cooled system

It is usually found on small machinery such as lawn mowers, chain saws and land masters.

Characteristics of air cooled system

- They are light in weight
- They are simple in construction and have got fins.
- Usually get hot quickly and cooling is not efficient.

2. Water cooled system

It uses water as the coolant

Advantages of water as a coolant

- It has a very high heat capacity i.e. requires a lot of heat for its temperature to change considerably.
- It has very low viscosity and therefore circulates freely.
- It has a wide temperature range in liquid state.
- It can readily and cheaply be obtained.

Components of the water cooled system

The major components include radiator, water houses, water pump, thermostat and the fanning system.

Action

As the engine runs, its parts get heated up; cold water is pumped by the impeller from the radiator through the bottom hose to the engine block.

The water carries heat from the engine parts as it circulates before returning to the radiator through the top hose. In the radiator, the water is cooled before its pumped back into the engine.

NOTE:

1. The thermostat regulates the body temperature by ensuring that the valve only opens at a temperature above 70oc.
2. Water in the radiator is cooled by the help of a fan that blows air over it.

Maintenance of the water cooling system

1. The radiator should always be filled with clean soft water.
2. The fan belt should be adjusted to the correct tension for efficiency.
3. Any leakage in the system should be repaired.
4. The radiator should be frequently cleaned referring to the instruction manual.
5. Radiator fins should be well cleaned of any dirt which may cause insulation.
6. The water pump should be lubricated weekly with grease.

LUBRICATION IN FARM MACHINERY

Lubricants: - a lubricant is a substance that reduces friction between two moving surfaces in machinery. Examples of lubricants are oil and grease.

General functions of lubricants in farm machinery

- (i) They reduce friction between the moving parts.
- (ii) Oil helps in cooling down moving surfaces.
- (iii) Lubricants reduce unnecessary tear and wear of moving parts.
- (iv) They act as sealing agents e.g. between piston and cylinder walls hence retaining compression.
- (v) Lubricants act as flushing agents i.e. they wash cylinder surfaces and protect them from corrosion.
- (vi) Lubricants prevent rusting of metal surfaces.
- (vii) Oil helps to absorb or reduce noise in the engine.
- (viii) Lubricants act as shock absorbers i.e. they absorb shocks that would occur on the bearings.

Qualities of a good lubricant

1. It should have a reasonable viscosity: - it shouldn't flow freely and rapidly at room temperatures.
2. It should have a high flash point: - i.e. shouldn't easily ignite and burn at high engine temperatures.
3. It should have high film strength: - i.e. should be able to resist pressure.
4. It should have a high relative density.
5. It should be smooth and slippery i.e. oily.
6. It should have a good body i.e. thick enough to prevent contact between two moving parts.
- 7.

Oil contaminants

These are impurities that tend to mix with oil and reduce its lubricative efficiency. They include;

- Moisture
- Dust and grit
- Metallic particles
- Soot and carbon deposits
- Acids

Major parts of the tractor lubrication system

1. **Oil pump:** - This pumps the oil and maintains it at the required pressure through the engine.
2. **Oil filters:** - These remove solid impurities and clean up the oil before it gets to the engine.
3. **The jump:** - It acts as a reservoir for oil. It also collects the oil after it has circulated through the engine.
4. **Oil ways (galleries):** - These are holes drilled in the cylinder block, crank shaft and cylinder head to deliver oil at the required pressure to all bearings.

Types of lubrication system

(a) Splash feed lubrication system;

In this system, the cranks of crankshaft are dipped in oil and splash it up as they move.

(b) Oil mixed lubrication system:

It involves use of mixture of oil and fuel and lubrication occurs as some parts of the engine are in operation.

(c) Forced feed lubrication system:

Maintenance of the lubrication system

1. Engine oil should be checked with a dip stick and if necessary.
2. Oil should always be changed according to manufacturers manual.
3. Use only the correct and recommended type of oil.
4. Oil filters should always be replaced along with oil.
5. Contaminated oil should never be used.
6. Seal off any leakages from the system.
7. Oil should always be drained when it's still hot to avoid chances of sticking on the walls of the engine block.

THE ELECTRICAL SYSTEM

Functions of the electrical system

- (i) To provide a spark in petrol engine to ignite the fuel air mixture.
- (ii) Provides power for lighting head lamps, indicators etc.

- (iii) Provides power to operate the horn and the wipers.
- (iv) It lights and operates various gauges on the dash board.

The electrical system consists of 4 circuits, namely

1. Ignition circuit
2. Stator motor circuit
3. Generator circuit
4. Lighting circuit

All these depend on the battery for operation.

1. Ignition circuit Components

Functions of the parts

- (i) **Battery:** - It supplies the initial electric current to the ignition coil.
- (ii) **Ignition coil:** - This steps up the low voltage (12v) supplied by the battery to high voltage (110,000v) required by spark plugs.
- (iii) **Spark plugs:** - It provides an air gap across which the current passes to cause a spark that is used to ignite the air fuel mixture in the cylinder.

Parts of the spark plug

- (iv) **Switch:** - It completes circuit connection to the battery.
- (v) **Distributor:** - Found on engines with more than one cylinder. It distributes electric current to the respective spark plugs.
- (vi) **Contact breaker points:** - These break the primary circuit and as a result, the current drops and a high voltage is produced in the secondary winding.
- (vii) **Condenser:** - It cuts down current in primary winding hence reducing sparking at contact break point.

2. Dynamo or generator circuit

It largely consists of the dynamic or generator. It generates electricity for recharging the battery.

3. Starter motor circuit

It consists of the starter motor whose prime function is to start the engine by turning the fly wheel mechanically.

4. Voltage control box (cut out)

It adjusts the charge from generator to battery and disconnects when the engine is stopped.

How electric power is used in starting the engine

When the switch is turned on, current flows from the battery through the primary circuit to ignition coil.

Here, electromagnetic induction occurs and a very high voltage is created as current flows through the secondary circuit.

This voltage is then distributed to the spark plug of the cylinder at compression and the air fuel mixture is ignited. This forces the piston downward and sets the engine running subsequently.

Maintenance of the electrical system of a tractor

(a) Battery

- (i) The level of electrolyte should be checked and topped up with distilled water if necessary.
- (ii) Keep the casing and terminals of the battery clean and dry.
- (iii) Ensure that the battery is firmly fixed in its box to prevent spillage and damage due to engine vibrations.
- (iv) Frequently check the specific gravity of electrolyte using a hydrometer and add more sulphuric acid if the S.G is below 1.25
- (v) The terminals should be correctly connected.
- (vi) The battery should always be fully charged when its in wood.

(b) Spark plugs

- (i) gap should be kept clean and free of soot.
- (ii) Gap should be adjusted to the appropriate width.
- (iii) New plugs should be fitted in case of mal functions.

(c) Connecting wires

- (i) Ensure that they are firm, rightly connected and properly insulated.
- (ii) All cracked old wires should be replaced.

TRANSMISSION SYSTEM

It transfers power from the engine to the wheels.

Components of the transmission system

1. Clutch assembly
2. Gear box
3. Differential

1. Functions of the clutch assembly

- (i) It connects and disconnects the drive shaft with the engine.
- (ii) It helps the vehicle to take off gradually and smoothly.
- (iii) It helps to provide power from engine to P.T.O shaft.

2. Functions of the gear box

- (i) It helps the driver to achieve forward or reverse motion by selection of respective gears.
- (ii) It facilitates easy application of engine power in performance of external work.
- (iii) It enables the driver to stop the movement of the vehicle without stopping the engine. This can be done by selection of the neutral gear.
- (iv) It facilitates adjustment of the drive speed by selection of different gears.

3. Functions of the differential

- (i) It changes rotation of the drive shaft to right angles such that power is transmitted to rear wheels.
- (ii) It adjusts the speed of drive such that the operator operates at a lower speed than that of the engine.
- (iii) It enables of each of the rear wheels to travel (independently) faster or slower than the other, a benefit when turning around corners.

THE WHEELS

These have got tyres for grip. They functionally provide forward or back propulsion of the vehicle.

Methods of increasing friction (grip)

- 3. Reducing tyre pressure: - this increases the surface area of contact on the ground.
- 4. Addition of weights: - e.g. at front or rear. It increases stability and provides more grips.
- 5. Increasing the number of rear tyres: - if possible, particularly on rear axles. It serves to increase area of contact on the ground.
- 6. Using metallic wheels:- these are more stable but are not recommended on public roads.
- 7. Ballasting the tyres: - water can be added to the inner tubes.

AGRICULTURE ECONOMICS

Economics is the study of how man chooses to use the scarce resources to satisfy his unlimited wants. Every society faces a problem of scarcity of resources be they natural, human or capital. However, human wants are unlimited, dynamic, competitive recurrent and therefore insatiable.

Economics helps the producers to know:

- (i) What to produce.
- (ii) How to produce.
- (iii) Where to produce from
- (iv) For who to produce.
- (v) How and when to buy and sell.

There are two approaches to the study of economics i.e.

Microeconomics: which is the study of the economic behavior of small groups and individuals e.g. firms, household, the distribution of goods and services, price determination etc.

Macroeconomics: which is the study of large units e.g. the economy in aggregate. It studies such aspects as national income, economic growth, employment and unemployment etc and their interrelationship.

PRODUCTION

This is the process in which resources are transformed into products usable by a consumer. It is therefore the creation of utility.

Utility is the ability of a good or service to satisfy human wants. Utility is of there types:

- (i) **Form utility:** the good must be in the form in which it is able to satisfy human wants.

- (ii) **Place utility:** The good must be available in the place in which it is required to satisfy human wants.
- (iii) **Time utility:** the good or service must be available at the time in which it is required.

Factors/ resources of production

There are four basic factors required for production to occur i.e. land, labour, capital and entrepreneurship.

Land: Is a gift of nature. It refers to the surface of the earth and all the natural resources on it e.g. forests, minerals, air, water etc.

Land is not homogenous, it is immobile and its supply is fixed. However, its quality can be increased by use of fertilizers and by reclamation.

Payment for use of land is called RENT.

Labour: Is the human effort extended in production. It can be skilled, semi skilled or unskilled.

The importance of labour

- It utilizes land and capital for production to occur.
- It determines the value of good. Labour intensive products are very expensive.
- Production ultimately aims to satisfy labour since the labourers are the humans for whom the good are intended.
- The quality and motivation of the labour forces determines the output from a productive venture.
- It creates capital by the accumulation of the rewards it gets from offering the labour.

Characteristics of labour:

Labour is human effort and is provided by human beings.

Labour can not be separated from its owner.

Labour is mobile i.e. can be moved from one place to another or from one job to another.

Labour can be inherited unlike land or capital since each individual owns personal skills.

Labour has a high opportunity cost. It takes a lot of time, effort and money to train Labour. This resource could have been used otherwise.

Labour has a will of its own unlike land or capital. It has the capacity to make its own decisions or modify instruction given to it.

The availability of labour is affected by

The total population: the larger the total population, the greater the availability of labour.

The percentage of the total population in the labour force: the larger the percentage of the population in the working age bracket, the greater the availability of labour.

The wage rates: the higher the wage rates, the more attractive the job and the more willing people will be to offer their labour.

Health of workers: the healthier the labour force, the more the account of labour they can provide.

Average hours worked per day per person: where the people are required to work for long hours on single task, there will be less labour in circulation than when the people can work for shorter hours and therefore do more than one job.

Capacity and output of workers: some workers are bound to be more productive than others due to differences in motivation, level of training etc.

The level of skills required: for jobs that require high skill level, labour supply is more limited than where the job requires little skills.

Mobility of labor geographically and occupationally: where people can move easily from one job to another or from one locality to another, labour supply is greater and more even than when the people can be less mobile.

Working conditions: where the working conditions are ideal, more people are attracted into the labour force.

Political stability: areas that are free of insurgency attract more labour than those embroiled in conflict.

Knowledge of job opportunities: the laborers will offer their labour more if they know of the existing job opportunities.

Nature of job: some jobs are more attractive than others. Risky job may not be attractive even when the financial rewards are great.

Retirement benefits: people are more attracted to those jobs that offer a favorable retirement package for them when out of the job.

Net flow of labour force e.g. through emigration and immigration.

Attitude towards work: some people may not want to work especially in those countries that offer favorable social benefits for those out of work.

Payment for the use of labour is called a WAGE.

Efficiency of labour:

This is the ability of labour not only to stick to the expected routine but also to accomplish the required objectives in time.

Ways of increasing the efficiency labour:

- **Provision of transport:** Proper transport ensures that workers are at their station on time and avoids loss of man thus increasing their efficiency.
- **Provision of housing:** This increases the workers' comfort and their esteem and avoids loss of man hour as employees commute from far off residences. This increases their efficiency.
- **Appropriate remuneration:** When workers feel that they are not just being exploited, they invest more effort in their work and are therefore more efficient.

- **Specialization:** Giving workers specific tasks to enable them to develop better skills on the job and become more efficient.
- **Adequate supervision:** Workers should be given adequate supervision to ensure that they work as expected. Provision of health service: a healthy work force is more efficient than a diseased one.
- **Provision of meals at work:** If workers are well fed while at work, they work better than when they are offered no food throughout the day.
- **Giving appropriate load to workers:** Humans suffer from diminishing returns the longer and harder they work. They should then be given appropriate load to ensure their efficiency.
- **Proper handling of employees/ man management:** Treating the workers appropriately increases their efficiency.
- **Training of labour:** This improves upon their skills and so increases their efficiency.
- **Provision of machines:** Machines increase the speed, accuracy and output of labour and so increase its efficiency.
- **Provision of entertainment:** This reduces stress while at work and so increases efficiency.

Capital: These are resources made by man to facilitate the production of other goods.

Capital is of two types.

Real capital: a stock of physical assets e.g. roads, railways, factories building, etc

Money/ financial capital: money invested into the business to produce more goods and services.

The role of capital in the production process

- It increases the effectiveness of the labour force by provision of machines, tools and equipments.
- It enables the exploration and fuller utilization of the available natural resources.
- It increases the productive capacity of a nation by exploiting the idle resources.
- It improves the quality and quantity of the national output, which raises the national income.
- Real capital can be used as collateral security for bank loans.
- Capital can be exported to other countries to generate other income.
- Capital helps the entrepreneur to mobilize land and labour.

Payment for use of borrowed money is called **interest** while returns on capital are called profits.

Entrepreneurship: An entrepreneur is someone who runs the business to make a profit.

The entrepreneur:

- Combines the other factors of production to make production possible.
- Bears the risks and uncertainties.
- Controls management.

- Co-ordinates the other factors of production.
- Carries out innovation.
- Hires and pays the other factors of production.
- Finds market.
- Raises capital.
- Is the overall supervisor of the production process?

The return on good entrepreneurship is PROFITS. Profits are the excess of revenue over the expenses involved in the production process.

Profits may be classified as normal or abnormal. Normal profits are those that are just enough for an enterprise to remain in production but not enough for new firms to enter the industry. They are common in the long run.

Abnormal profits are those above the normal profits. They are usually earned in the short run and they reduce other firms to join the industry thus increasing output and reducing the abnormal profits to normal ones.

PRODUCTION FUNCTION

This is a physical relationship between inputs and outputs. It shows how the quantity of a particular product varies with the amount of inputs used in a specific time period.

Types of production function:

There are three types of production function i.e.

- (i) **Constant returns:** The amount of product increases by the same amount for each additional unit of input used.
- (ii) **Increasing returns:** Each additional unit input results in a larger increase in output than the previous one.
- (iii) **Diminishing returns (decreasing returns).** Each additional unit of inputs results in a smaller increase in output than the previous one it is the most common in agriculture.

The Law of Diminishing Returns:

It states that when successive units of a variable factor are added to a certain amount of a fixed factor, a time comes when extra units of a variable input will give less and less output.

Definition of common terms:

Fixed inputs: Inputs which cannot be varied easily within the production cycle e.g. land.

Variable inputs: Inputs whose quantity can be varied/ changes easily within the production cycle e.g. labour fertilizers and capital.

Total physical product: This is the total amount of products got from an activity.

Average product: The total physical product divided by the total quantity of input used.

Marginal product: This is the extra product obtained from an extra unit of input used i.e. $MP = \text{change in total product} \div \text{the total number of extra inputs used}$.

Marginal cost: The cost of producing each additional unit of output. It is given by $\text{change in total product}$

Marginal revenue: The income got from selling marginal products.

Total revenue: The total amount of money received from selling all the product of the activity i.e. $TRR = TPP \times \text{Price of product}$.

Total costs: Total inputs x costs of inputs.

Example:

A farmer has one acre of land (fixed input) and employed different quantities of labour (variable factor) to grow maize. The results may be as shown below:

Land (Acres)	No of men	Total product	Average product	Marginal product
1	1	08	08	-
1	2	20	10	12
1	3	36	12	16
1	4	48	12	12
1	5	55	11	07
1	6	60	10	05
1	7	60	8.6	00
1	8	56	09	-4

Source: Kagwa: Economics: An integrated Approach, Vol. 1, 5th Edition.

Graph to illustrate the law of diminishing returns

Zone I: There are increasing returns for every extra unit of input used. The region occurs when MP is greater than AP and ends when AP is maximum. The resources are under utilized and the farmer can make more and more profits by using more of the variable input as long as the AP is increasing. Most farmers in Africa operate in this zone but it is irrational.

An example of this zone is a farmer who has been growing crops without applying any fertilizers. When such a farmer begins applying the fertilizers, yields begin to increase.

Another example is that of a farmer who has been keeping livestock on natural pastures. When such a farmer introduces a few units of concentrates or improves on the pasture, the yields begin to increase.

Zone II: This is the zone of rational action. It occurs when MP is decreasing and is less than AP but greater than zero. In this region, the farmers are utilizing their resources at the maximum. The TPP increase at the decreasing rate zone stops when MP becomes zero i.e. when further increase in the amount of variable inputs gives no increase in output. This is where the zone ends. It is the most profitable zone to operate in because the resources are being optimally utilized. Profits are however at its maximum when marginal cost is equal to marginal revenue.

Zone III: This is also a zone of irrational action. In this region, further additions of variable inputs result in decreasing TPP and negative MP. The resources are being over utilized. Increase in the amount of variable inputs used results in a decrease in the output.

Examples of farmers operating in this zone include;

A farmer with one acre of land applying so much fertilizer that the yields begin to decline because the fertilizers have become toxic.

A farmer feeding his livestock on too much protein concentrate that toxicity arises causing reduced yield and poor growth.

COSTS OF PRODUCTION

Expenses incurred in the production process can be divided into

- (i) **Money costs:** These are the monetary expenses incurred by the firm in the production process. They include wages and salaries, costs of the raw materials, cost of machinery and equipment, rent, depreciation costs etc
- (ii) **Real costs:** These are the non monetary costs of production e.g. the sacrifices that have to be made by the society and entrepreneur in order to produce e.g. the time and effort taken to save the capital and the opportunity cost.

The costs can further be classified as explicit costs or implicit costs.

- (e) **Explicit costs:** These are costs directly incurred by the firm. They are easy to recognize and quantify e.g. the cost of hired labour, power costs and the cost of raw materials.
- (f) **Implicit costs:** These are costs not easy to recognize and quantify e.g. the cost of self owned, self employed resources and services, rent on own building etc.

The money costs of production can also be sub divided into fixed and variable costs.

- (i) **Fixed costs:** These are costs that do not vary with the level of production. A firm incurs them whether it is producing or not. They include.
- Salaries of the permanent staff
 - Rent for buildings
 - Interest on borrowed capital
 - Depreciation costs
 - Insurance premiums

Fixed costs are also called supplementary, indirect, overhead or unavoidable cost. Change in total cost

- (ii) **Variable costs:** These change with the level of out put e.g.
- The cost of raw material
 - Labour expenses
 - Cost of fuel

Variable costs are also called prime costs, indirect costs or avoidable costs.

- (iii) **Total costs:** These are a summation of the total fixed costs and the total variable costs.

- (iv) **Average fixed costs:** This is the fixed cost per unit of output. i.e.

$$AFC = \frac{\text{Total fixed cost}}{\text{Total output}}$$

- (v) **Average variable cost:** This is the variable cost per of output i.e.

$$AVC = \frac{TVC}{TP}$$

AVC is inversely proportional to AP.

- (vi) **Marginal cost:** This is the change in total cost when out is changed by one unit i.e. it is the cost of producing one additional unit of output i.e.

$$MC = \frac{\text{Change in total cost}}{\text{Change in output}}$$

Marginal cost is inversely proportional to marginal product.

REVENUE

Revenue is what a firm receives from selling its output. The cost and revenue determines the level of profitability of the firm.

Total revenue refers to the total receipt of a firm from the sale of a given quantity of output at a given price.

Average revenue is the revenue got per unit of output sold i.e.

$$\text{Average revenue} = \frac{\text{Total revenue}}{\text{Quantity sold}}$$

Average revenue is therefore equal to the price of the commodity.

Marginal revenue: this is the addition to total revenue as a result of selling an extra unit of output.

$$\text{MR} = \frac{\text{Change in total revenue}}{\text{Change in quantity sold}}$$

Reducing fixed costs

- (i) Maximize production to reduce the unit cost of production
- (ii) Diversify production to ensure that losses incurred in one product are covered by another product to reduce on the burden of having to pay permanent staff during periods when production of a single product may not be going on and to minimize the need for paying insurance premiums.
- (iii) Have a flexible capital outlay to enable you move quickly from a loss making venture to a more profitable one and so cut the losses.
- (iv) Employ appropriate assets for optimum return
- (v) Properly maintain the fixed assets to reduce decay and depreciation and prolong their useful life.

Using a production function to determine the point of highest return:

- Set out an experiment to collect the appropriate data to use.
- Use different quantities of variable inputs on a fixed amount of fixed input.
- Collect relevant data on Total Product, Total Revenue and Marginal Revenue for the different amounts of variable inputs.
- Use the data to calculate the total costs, marginal costs and marginal revenue.
- Plot a graph of costs and revenue against inputs.
- Draw a line parallel to the cost curve but tangent to the total revenue curve.
- The point of highest return is when total cost curve is tangent to the total revenue curve.

OR:

- Using the data from the above experiment draw a curve of marginal cost and marginal revenue against inputs.
- The point of highest return is where marginal cost is equal to marginal revenue ie where the marginal cost curve cuts the marginal revenue curve.

OPPORTUNITY COST

This is the value of the second best alternative that is foregone in using a resource e.g. if a firm had only 1 acre of land it could produce 700kg of maize or 400kg of beans. The opportunity cost of producing the maize would be 400kg of beans and the vice versa. The farmer can decide to produce both the maize and beans but that would mean producing less of each.

The above illustration shows that to produce 700kg of maize, the farmer would completely have to forego beans and to produce 400kg of beans the farmer would have to forego maize completely.

The idea of opportunity cost is applied in the making of choices. It helps farmers make up their minds on which farm enterprises to run and how to combine them to achieve the highest economic returns.

Importance of the opportunity cost concept

- (i) It determines the consumption and expenditure patterns of the people i.e. choice have to be made where the opportunity cost is lowest.
- (ii) It determines the prices of goods. Price of goods and services are a reflection of opportunity cost.
- (iii) It is important in the principle of comparative advantage that advocates that people and nations produce those commodities in which they incur the least opportunity cost.

Note: The highest return from a unit of input is realized when the actual earned return is equal to or greater than the opportunity cost.

The production possibility frontier

This shows a combination of commodities that can be provided by a society using its limited resources.

It is based on the following assumptions.

Only two commodities X and Y can be produced given the level of resources.

Full employment of resources

The level of technology is constant.

A short run situation is considered.

The production possibility frontier curve

The curve ABCB is the production possibility frontier curve. All points on the curve depict a situation of full employment of resource. Any point inside the curve indicates that the resources are not fully employed.

To increase the output of Y from OF to OE, a reduction in the output of X from OI to OH has to be made.

The PPF curve will shift outwards if

- The state of technology
- The stock of resource has increased
- There is better organization of the production process.

PRODUCT - PRODUCT RELATIONSHIPS

The relationship between two products from a given quantity of resource can be of several kinds.

Joint products: These are produced through a single production process i.e. one cannot be produced without the other e.g. butter and butter milk. Lamb and wool, beef and hides, cotton and cotton seed.

Competitive products: Two products are competitive if increase in production of one necessitates a decrease in production of the other given a fixed amount of inputs. Most products are competitive in nature e.g. growing maize and rice on the same piece of land, keeping cattle and pigs on the same farm and growing crops and keeping livestock on the same farm.

Supplementary products: Two products are supplementary if production of one can be increased without of the other.

Production of Y1 can be increased without affecting the production of Y2 in the range A-B while without of Y2 can be increased without affecting the output of Y1 in the region D-C.

An example of a supplementary relationship is when permanent labour on a farm may be used to run a small pig enterprise without affecting the output of the other farm enterprises.

Also, labour and machinery on a farm may be used for transport without affecting crop production.

Keeping a few chickens on a dairy farm may also not affect the output of the dairy enterprises.

All supplementary relationships are however short lived and a continuous increase in the production of one will eventually into a competitive relationship.

Complementary products: These are products in which the transfer of resources from one product to another result in increased out of both products.

An example of a complementary relationship is the growing of legumes in a crop rotation. The legumes add nitrogen to the soil, which increases the yield of the subsequent grain crops.

Also, the growing of legumes in a pasture increases the net pasture production by providing nitrogen to increase grass growth.

Grazing cattle and sheep on the same pasture has a complementary effect. This is because the cattle and sheep have different grazing habits. While the cattle are more selective and feed on the taller and more succulent parts, the sheep will eat the shorter and more fibrous parts eventually giving a better utilization of the pasture and a better pasture production due to proper removal of the old fibrous parts to allow re-growth of younger, more nutritious parts.

Optimum product combination

A ration producer operates in the range in which the products are competitive. This is because this is a region in which the resources are fully utilized.

Specialization and diversification

Specialization

This is where resources are concentrated in the production of one commodity or relatively few commodities. It is very common where the products have a competitive relationship.

There is usually surplus of a particular commodity in specialization hence the need for mechanism to dispose off the excess.

Specialization is usually done in those commodities with the lowest opportunity cost and those which use the available resources intensively.

There is generally a low level of specialization in developing countries because the level of productivity is generally low hence low real incomes and thence low markets demand.

Advantages / benefits of specialization

- There is mastery of the job due to the frequent repetition of the tasks.
- There is increase in the quality of and quantity of produce due to the mastery of the production process. Less time is then spent per unit produced.
- It creates the need for trade to dispose off the surplus and this promotes cooperation and interdependence between people and countries.
- Wastage is reduced as the resources are put to their best use by the skilled workers efficiently.
- Specialization facilitates mechanization. Machines suited to the tasks at the hand are developed and used.
- There less fatigue since the physical and mental strain will be reduced by reputation and mechanization of tasks.
- Increased productivity leads to reduced cost per unit of output hence reducing the price consumers have to pay.
- There is easier marketing of the one or a few products produced since specialized lines e.g. automated vendors can be developed to market a single product.

Disadvantages / problems of specialization

- There is over dependence on other to provide what one has not specialized in.
- People who specialize in a given commodity suffer more in case of price fluctuation.
- It may lead to overproduction of a commodity.
- The monotonous reputation of tasks leads to boredom.
- It limits the range of commodities available in a locality.

- Occupation mobility of labour i.e. changing from one job to another becomes difficult.
- Workers may become inefficient on the job as the sense of responsibility is hampered by over specialization i.e. complacency sets in.
- There is non-utilization of resource e.g. labour, ploughing implements etc for part of the year if crops are specialized in.
- Income may not be constant through out the year since many agricultural products are seasonal.

Diversification

Is the production of several products at the same time or the production and sale of the same product at different time of the year.

Diversification is very common I products that have complementary or supplementary relationships.

Benefits of diversification

- Farmers spread the risk of loss over many products such that failure in one may be covered by gains in another.
- Farmers or countries are more dependent and self-sustaining than those who specialize since they provide a wider range of products for themselves.
- It reduces seasonality of income because of producing and selling a variety of products in different season of the year.
- It reduces seasonal unemployment because the activities are more spread through out the year. Also more avenues for employment are created in the diversified activities.
- It widens the export base of a country, generates more income and thus enables a country to stabilize its balance of payments
- It stable income increased sure flow of foreign exchange into a country / person s coffers enables long term planning of the economy.
- It is a step towards achieving a balanced regional development and an equitable income distribution. Each region and individual produces a wider variety of products and hence higher incomes are earned.
- There is integration of farm by-products e.g. crop residues may be used to feed livestock and poultry litter may be used to improve soil fertility.

Disadvantages of diversification

- It is more difficult to select and manage a combination of enterprises than it is to manage a single or a few enterprises.
- It requires a multi- skilled labour force to manage the diversified enterprises.
- Pests and diseases may spread from one enterprise to another.
- It is more difficult to organize the marketing of several products than it is to set up a network to market one product.

RISKS AND UNCERTAINTIES

These are unforeseeable and unavoidable hazards which face entrepreneurs. They make it very hard for the farmers to accurately predict the outcomes from their inputs in the production process.

RISKS

These are hazards, whose probability of occurrence can be estimated based on past experiences and therefore can be insured against. A risk is the divergence between the actual and expected results.

Examples of risks include.

- **Whether changes:** These may bring about draught, excessive rains, floods, frost, hailstones, and violent storms. All these affect crop yields and may damage crop yields, farm property and may lead to loss of life.
- **Fire / arson:** Fire may cause destruction of farm products, property and life.
- **Theft:** this may cause loss of crops, machinery or livestock.
- **Accident to employees and employers:** These may cause unforeseen costs of treatment and loss of labour.
- **Pests and diseases:** Some outbreaks of pests and diseases are sporadic and may be hard to control causing serious loss.
- **Crop yields:** Due to a variety of factors, crop yields may not be as good as expected hence affecting the farmers adversely.
- **Health of the farmers and (or) members of his family:** Farmers or the members of their families may fall sick at a time when demand for labour is very high.

UNCERTAINTIES

These are hazards whose occurrence cannot be predicted by probability estimates and therefore cannot be insured against. Uncertainty is the state of imperfect knowledge.

Example of uncertainties includes:

- **Price fluctuations:** Price may rise or fall erratically making planning by the farmer difficult.
- **Change in demand:** This may make a farmer line of products unmarketable.
- **Technological changes:** These may make machinery and farming techniques obsolete rendering the farmer's production process uneconomical and sending him or her out of business.
- **Transport reliability:** Transport may be unavailable when needed.
- **Change in government policy:** government may change the tax regime, remove subsidies or ban a product.

- **Breach of contract** e.g. contracted supplier may fail to fulfill a promise of supplying feeds to livestock at a specific time.
- **Management uncertainty:** The policies and decisions of the people responsible for production may not remain constant e.g. the landlord may change his policies over tenure and the manager and his workers may go into conflicts.

Reducing risks and uncertainties

- (i) **Insurance:** Farmers contribute small amounts of money to a pool from which the unfortunate few losers are compensated to the value of their loss. Payments of the insurance premium transfer the risk of loss from the producer to the insurer.
- (ii) **Producing on contract:** Farmers should only produce after securing agreements on market and price. This transfers the risks associated with fall in price from the producer to the buyer.
- (iii) **Flexibility:** Farmers should easily change the organization of production from one enterprise to another. This enables the farmer to change from a loss making enterprise to a more profitable one.
- (iv) **Diversification:** Pursuing more than one enterprise at the same time spreads the risk of loss over several products and hence guards against total loss.
- (v) **Liquidity:** The farmer should be able to convert his assets into cash easily to enable him invest into a more profitable business.
- (vi) **Selecting the most certain enterprise:** Farmer should engage in those enterprises, which carry less risk especially if they are not very experienced.
- (vii) **Government support:** Government can support the farmers to protect them against risks and uncertainties e.g. by giving them price guarantees.
- (viii) **Building owner equity:** Farmers should try to have a high net capital so that even if there is a failure in one year, the farmer can still continue farming.
- (ix) **Input rationing:** Farmers should ration the inputs such that all are not used at a go. This means that even if there is a problem in one season, the farmer can continue producing because he / she will have some inputs in stock.
- (x) **Using relevant agricultural technologies** such as irrigation to overcome drought, spraying with pesticides to overcome pests, using quick maturing seeds etc

DEMAND

Is the amount of a commodity a person is willing and able to buy at a given price and time.

The desire for a commodity backed by the ability to pay for it is referred to as effective demand.

In Uganda, most families need more protein foods, such as meat than they are able to buy. Their effective demand for meat remains low while their real needs may be very high

The aggregate of all the individual consumers' demands is referred to as the market demand.

The Law of Demand:

It states that, other factors remaining constant, as the price decreases demand increases and the vice versa.

The quantity of a good demanded at different prices is referred to as a demand schedule. A visual presentation of the demand schedule is called a demand curve.

The demand curve

It shows that as the price increases, demand falls and the vice versa. It shows the relationship between price and quantity demanded.

Factors affecting demand

The demand for farm products is affected by a number of factors which the farmer may not realize influence his sales.

- **Price of a commodity:** As price increases demand falls and vice versa.
- **Price of other commodities especially substitutes and complementary goods:** When the price of a complementary good rises, demand for a commodity falls. Also when the price of a substitute falls demand for a commodity falls and the vice versa.
- **Income of the population:** The higher the income of the population the more the goods they can afford.
- **Tastes and preferences:** Each individual has different feeling about a good or service and is bound to buy that which satisfies his or her feelings.
- **Size of the population:** The bigger the population the more the goods it can buy.
- **Government policy e.g. taxation:** The higher the taxes the higher the price and so the lower the demand for a good.
- **Seasonal factors:** Some goods are demanded more in specific seasons than in other seasons e.g. in festive seasons, the demand for meat increases.
- **Availability of transport:** Transport widens the potential market for a good since the goods can be taken to far off markets.
- **Speculation:** Future expectations about a good increase or lower the demand for a commodity. If the price of a commodity is expected to increase in future, demand for that product will increase in the present as people stock up on the products.

- **Nature of the good i.e. necessity or luxury:** Necessities are often bought more than luxuries.
- **Structure of the population:** The proportion of the various age groups and sexes in the population determined what would be bought more since each group has its own needs.
- **Fashions:** People buy more of the good that is fashionable at the time.
- **Advertisement:** The level of advertisement controls the level of awareness about a good and so its demand. Goods that are advertised more tend to have a higher demand than those that are not advertised.

Elasticity of demand

- This is the responsiveness of demand to changes in the determinant factors of demand.
- Price elasticity of demand refers to the extent to which demand changes when price change.
- Price elasticity of demand is defined as the percent change in quantity demanded resulting from a 1% change in price.
I.e. $ED = \frac{\% \text{ change in } DD}{\% \text{ change in } P}$
- Point elasticity of demand measures the ratio of a very small change in quantity demanded to a very small change in price.
- Arc elasticity of demand measures the responsiveness of a quantity demanded to a relatively large change in price. It measures average elasticity over a portion of the demand curve.
The demand may be said to be elastic, unitary or inelastic.
- Demand is said to be elastic when a small change in price causes a larger change in quantity demanded and so the co-efficient is greater than 1. a reduction in price leads to a big increase in quantity demanded and therefore an increase in total revenue.
- Demand is said to be unitary when the percent change in price is equal to the percent change in quantity demanded i.e. the elasticity co-efficient is equal to 1. an increase or decrease in price has an equal effect on quantity or decrease in price has an equal effect on quantity demanded and therefore on the total revenue.
- Inelastic demand occurs when a fairly big change in price causes a less than proportionate change in quantity demanded i.e. the co-efficient is less than 1. a decrease in price would lead to a fall in total revenue.

Calculating elasticity of demand:

E.g. in the month of June 2004, a kilo of sugar cost shs 1200 and the shop keepers in Walugogo estate sold 20bags a week. In August 2006 the price sugar rose to shs 2400 and the shop keepers sold 16bags a week.

Elasticity of demand = $\frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$

% change in price

$$\% \text{ change in demand} = \frac{\text{New demand} - \text{Original demand}}{\text{Original demand}} \times 100$$

$$= \frac{16 - 20}{20} \times 100 = 20 \text{ (Ignore Signs)}$$

$$\% \text{ change in price} = \frac{\text{New price} - \text{Original price}}{\text{Original price}} \times 100$$

$$= \frac{2400 - 1200}{1200} \times 100 = 100$$

$$= \frac{20}{100}$$

$$= \underline{\underline{0.2}}$$

Factors affecting the price elasticity of demand

- (i) **The availability of substitutes:** Where close substitutes are readily available, a commodity will have elastic demand and if close substitutes are not readily available, demand will be inelastic.
- (ii) **The degree of necessity of a commodity:** Commodities such as paraffin and salt that are necessities have inelastic demand while luxuries such have elastic demand.
- (iii) **The number of uses a product can be put to:** The more the number of uses a commodity can be put to, the greater the degree of elasticity. This is because as the price falls, the people buy more of the product and put it to more uses and if the price rose, they would cut down their consumption of the product and limits its use to the most essential purposes.
- (iv) **Joint demand:** For commodities that are jointly demanded e.g. shoes and shoe polish, the elasticity of demand for the second commodity depends on the elasticity of demand of the major commodity.
- (v) **Durability of the commodity:** Commodities whose consumption can be deferred e.g. durable goods have elastic demand while perishable goods have inelastic demand.
- (vi) **Addiction and habit:** Addictive and habit forming commodities such as cigarettes, drugs and alcohol tend to have inelastic demand.
- (vii) **The level of income of the consumer:** Generally, the higher the income of the consumer, the more inelastic will his/her demand for commodities i.e. his demand for the commodity may not be affected by price increases.

Change in demand and change in quantity demanded

Change in quantity demanded

This is a movement along the given demand curve caused by changes in the price of a commodity itself e.g. let us assume that the income of Mr. Manama changes. This will affect the amount of commodity such a person will buy. If this person has:

- High income, the demand will increase.
- A lower income, the demand will decrease. moving from A to C on the diagram below;

Change in demand

This occurs when the quantity demanded at any particular price changes causing a shift of the entire demand curve either to the left or to the right. It is due to changes in other factors that affect the demand for a commodity other than the price of the commodity itself.

SUPPLY

Is the amount of a commodity producers are willing and able to offer for sale at a given price and time.

When the price is high, we expect the farmers to supply more of that commodity in the market because they will receive more money. On the hand when prices fall, the farmers make less profit from their sales and are discouraged from producing. So this results in a decrease in supply. In agricultural production, the supply does not respond so easily to the change in price.

The supply schedule shows the amount of a good or service that producers are willing to offer for sale at different prices, other factors held constant.

The Law of Supply

It states that, other factors constant, when price increases, supply increases and when price falls, supply decreases.

The Supply Curve

It shows the relationship between price and quantity supplied. Generally it shows that supply increases with increase in price and falls with decrease in price.

Subsistence Agriculture supply

Where a subsistence farmer produces very little and only wishes to sell enough to satisfy his basic and immediate needs, the supply does not increase but actually decrease even if market price rise. Here the supply curve is reversed (Back wards sloping curve)

Factors affecting supply:

- **Price of commodity:** Other factors held constant, when price is high supply is high and the vice versa.
- **Prices of other commodities** e.g. substitutes and complementary goods: when the price of substitute X which can produce instead of Y increases, producers may

change from the production of Y and instead produce X thus increasing the supply of X and reducing the supply of Y.

- **Number of producers in the market:** The higher the number of producers the more the goods produced and the higher the supply.
- **The level of technology:** The higher the level of technology used the more the goods produced.
- **Government policies:** Government may encourage the supply of a commodity through subsidies, tax holidays for the producers, and by encouraging its production through the mass media. It may also discourage its production by increasing the tax burden on the producers, banning its production etc.
- **Season of the year:** Most agricultural goods are seasonal in nature and are thence more available in certain season than in others.
- **Political stability/ instability:** The level of stability affect the ease of production and so the supply of a good.
- **Gestation period** i.e. time it takes to produce a commodity. The longer the gestation period, the lower the supply of the commodity.
- **Cost and availability of factors of production:** If the factors of production are available and cheap more goods will be produced and supplied.
- **Natural hazards** e.g. drought, flooding etc may make production impossible and so lower the supply of the commodity.
- **Goal / aim of the producers i.e. whether profits or charity:** Goods produced for charity will be put on market even when price are low while those intended for price maximization will not be put on the market when prices are very low.
- **Specialization i.e. what producers expect in future:** If the producers expect price to rise in future they tend to hoard their goods and so reducing supply.
- **Transport and communication:** These tend to increase the supply of goods can be brought in from whenever they have produced.

Change in quantity supplied and change in supply

Change quantity supplied

This is a movement along a given supply curve which donates a change in quantity supplied resulting from a change in price of the commodity; other factors remaining constant i.e.

Change in supply

A change occurs when the entire supply curve shifts either to left or to the right due to change in the determination factors of supply other than the price of commodity in question.

Price elasticity of supply:

Is the percent change in quantity supplied resulting from a 1% change in price.

$$\text{i.e. } Es = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}$$

Supply is elastic when a small change in price of the commodity cause a more than proportionate change in the quantity supplied giving a co-efficient greater than one. The slop of the supply curve will be gentle i.e.

Inelastic is when a big change in price cause a less than proportionate in the quantity supplied i.e. the co-efficient is less than one and the slop of the supply curve is steep.

Unitary supply occurs when a change in price causes an equal change in quantity supplied.

Perfectly inelastic supply is when quantity supplied is the same at all price levels.

Perfectly elastic supply is when price is the same at all level of output.

Calculating elasticity of supply:

E.g.: in the month of June 2005, a bag of potatoes cost shs 20000 and the farmers supplied 100bags to Iganga central market. In December 2005 the price of potatoes rose to shs 40000 and the farmers supplied 140bags

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

$$\% \text{ change in supply} = \frac{\text{New supply} - \text{Original supply}}{\text{Original supply}} \times 100$$

$$= \frac{140 - 100}{100} \times 100 = 40 \text{ (Ignore Signs)}$$

$$\% \text{ change in price} = \frac{\text{New price} - \text{Original price}}{\text{Original price}} \times 100$$

$$= \frac{40000 - 20000}{20000} \times 100 = 100$$

20000

$$= \frac{28.6}{100}$$

$$= \underline{\underline{0.286}}$$

Factors determining price elasticity of supply

- (i) **Gestation period:** The short run supply for goods that have long gestation periods such as coffee, vanilla and cattle while for goods that have short gestation periods such as tomatoes and broilers is elastic.
- (ii) **Perish ability:** Durable commodity have elastic supply while perishable commodities have inelastic supply.
- (iii) **Availability of factors of production:** Where factors of production are readily available, supply is elastic.
- (iv) **The ease with new firms can enter the industry:** Where entry is easy, supply is elastic and where there are barriers, supply is inelastic.
- (v) **Availability of spare capacity:** Where a firm is operating below full capacity, mobilizing more resources to achieve full capacity can easily increase supply and therefore supply will be elastic whereas for a firm operating at full capacity, supply is inelastic.
- (vi) **Capacity out required:** For goods that entail heavy capital outlay, supply is inelastic.

Price determination

In competitive markets, and under the assumption of profit maximization, price is determined by supply and demand.

The relationship between supply demand and price

The amount paid for a given commodity depends on both the demand and supply. The economic principle governing the price of farm products in a free market are illustrated by the information in the table below;

Supply and demand schedule for milk.

Price (Shs)	Amount supplied(liters)	Amount demanded (liters)	Excess demand (liters)
100	250	95	+155
80	220	140	+80
60	185	185	0
40	120	200	-80

20	85	240	-155
10	20	255	-235

- (i) Down ward pressure on the price supplies of milk are plentiful, but at high price of sh.100 per litre, the consumers only buy 95 litres. Supply exceeds the demand by 155 litres. The farmer is therefore, forced to reduce the price so as to avoid wastage.
- (ii) Demand deficit. At the price of shs10 per litre, the farmer is discouraged from supplying the milk, but the demand from customers is high, 255 litres. At his price there is shortage of milk in the market. This situation forces the price upwards.

Equilibrium price and quantity can be obtained where the supply and demand functions intersect. At the point where the market demand curve intersects the market supply curve, the quantity demanded by the consumers is equal to the quantity supplied and the point P_0 is the equilibrium price

If consumers supplied quantity Q_1 , there would be excess demand. This is because the quantity supplied would be less than the quantity demanded at that price (Q_0). The shortage of products would force the consumers to compete for the few products available thus pushing the price up to P_1 .

If suppliers produced quantity Q_2 there would be excess supply. This is because the producers would have supplied more than the consumers require at that price. (Q_0). For the suppliers to be able to sell off all their excess produce therefore, they would have to lower their asking price P_2 .

Factors affecting the price of a commodity

- (i) **Government policy:** Government can cause increase or reduction in the price of a commodity by reducing or increasing the tax burden on the producers who eventually pass on burden to the consumers.

- (ii) **Cost of inputs:** The higher the cost of inputs, the higher the prices of the commodities since the producers have to recoup their investments.
- (iii) **Marketing cost:** These include the cost of processing, storage, transport etc. the higher the costs, the higher the final prices of the commodities
- (iv) **Amount of goods on the market:** If the quantity supplied on the market is high, the price tends to be lower than when there are fewer commodities for sale on the market.
- (v) **Objectives of the producers:** Some producers want maximize sales and so will tend to cut the price to ensure high sales. Others want to maximize profits and so will tend to restrict supply and increase the prices.
- (vi) **Speculation:** Products may be expected to become scarce in the future. Such products will tend to command a higher price than those whose supply is expected to increase in future.
- (vii) **Quality of commodity:** Generally, the higher the quality of the product, the higher the price.
- (viii) **Demand for the commodity:** The higher the demand for the commodity, the higher the price charged for it.
- (ix) **Price of other goods:** If substitutes that are at a lower price are available, they will tend to depress the prices of their substitutes.
- (x) **Market structure:** In a competitive market, the forces of demand and supply determine price. In less competitive market, the producer may have the ability to collude and fix the price regardless of any other factors.

Importance of price in agricultural production

- ❖ **They stimulate production and determine what and how much to produce:** Producers interested in profit maximization will produce more of a commodity if it commands a high price. A low price forces consumers to shift their resources to the production of more profitable products.
- ❖ **They determine how to produce:** The aim of many producers is to maximize profits and in order to achieve this; the producer uses the most economically efficient production techniques. The techniques selected will however depend on the prices of the factors of production and the expected prices of the products. Extensive mechanization is for example viable only where prices of the products are high.
- ❖ **They determine the distribution of wealth and income:** Since many people get their income by selling one resource or another, the price of the resource they have to sell will reflect on the amount of wealth they can accumulate.
- ❖ **They determine the distribution of the product** i.e. they determine who consumes what. People will only consume those products that they can afford.
- ❖ **They act as an incentive to growth:** Higher prices and high profits encourage improvements innovations and inventions. A big sum of money is put into research and experimentation if the prices are high and this results into technological progress and economic growth.
- ❖ **It facilitates full utilization of resources in an economy:** High prices for the products enable the producers to have some money to save and re-invest. Also the

price money (the interest rate) will determine the level of investment into agriculture. If the interest rate is low, producers can borrow money to invest.

AGRICULTURAL MARKETING

The term marketing refers to all the processes involved in transferring the goods or commodity from the producer to consumer.

Marketing involves several activities that may be referred to as functions and these includes;

- (i) **Buying and assembling:** This involves purchasing small lots from producers and other small suppliers and bulking up the commodity, ready for the next operation.
- (ii) **Selling:** This includes in a broad sense, all the activities done to enable the presentation of the product to the consumer for buying in a form that is buyable. It includes advertisement, bargaining for a good price and the display of goods for sale.
- (iii) **Transportation:** This involves the physical movement of goods from the production centers to the consumption centers. It increases the size of the potential market since it enables the products to reach far off consumers.
- (iv) **Storage:** Most agricultural products are seasonal in nature and may need keeping in a safe place until they are required for consumption. Storage stability supply and reduces price fluctuations. Storage also helps in assembling of produce.
- (v) **Processing:** This is the changing of a product from the raw form to a more acceptable or easily utilizable form. It may be as simple as sorting or cleaning the products.

Importance of processing

- It prolongs the useful life or shelf life of a commodity e.g. the pasteurization of milk.
 - It eases utilization e.g. the grinding of maize into flour.
 - It reduces wastage due to spoilage.
 - It extends the period of availability of the product and so reduces fluctuation in supply. It therefore reduces the risks of famine.
 - It helps to reduce fluctuation in the price of food items by extending their availability.
 - It helps to destroy toxins in the products e.g. the heating of Soya beans destroys the trypsin inhibitor.
 - It adds value to the products by improving their quality in terms of colour, taste, flavor, etc.
- (vi) **Grading:** This involves the sorting of products into uniform lots according to colour, quality, shape, flavour, degree of ripeness etc. it makes distribution

more efficient because different grade can be sent to different places depending on the effective demand in those areas.

- (vii) **Standardization:** This makes sure that the products conform to certain established specifications of quality and quantity. Standardization has the following benefits;
- It enables the establishment of criteria for inspection and control to ensure that the products are safe for consumption.
 - It avoids exploitation of consumers by producers and helps to keep the price of a commodity constant in different places.
- (viii) **Packaging:** This involves putting the products into containers to facilitate handling and marketing. packaging has the following benefits;
- It reduces the bulk of the product and eases handling.
 - It reduces shrinkage and spoilage of the product due to environmental factors.
 - It facilitates quality identification since products of different quality are packed in different containers and labeled.
 - It assists in the advertisement of a product.
 - It reduces marketing costs by enabling self-service retailing.
- (ix) **Financing:** Money is required to finance all activities from buying the raw products to the final sale of the finished product.
- (x) **Bearing of risks:** Because of the time lag between the buying of the raw products and final sales of the finished goods, the goods are liable to change to damage by fire, theft or deterioration in storage. Also, consumers tastes may change or the demand for the final product may fall causing loss to the marketing agency.
- (xi) **Collection and analysis of market information:** Knowledge of the supply and demand conditions of the commodity is essential to the marketing process as it helps to determine where and when to buy or sell, the price at which to sell etc.

Characteristics of agricultural products that make them difficult to market

- (i) **Bulkiness:** Most of the agricultural products have value in relation to their weight. This cause problem in transportation and storage of the products especially when the costs are based on weight.
- (ii) **Perish ability:** Most of the agricultural products rot easily and need to be consumed in short time. Also, because many of them contain a lot of water and very nutritious, they are difficult to store.
- (iii) **Seasonality:** Most of the agriculture products are seasonal in nature; they are produced in bulk at one time of the year and are in a short supply at other times of the year.

Special problems in Agricultural marketing.

- Agricultural production is seasonal causing surpluses at harvest time which must be store or sold.
- Many products have long production cycle hence there is uncertainty for the farmer of the price he will receive. Coffee for example involves more uncertainty than maize.
- Most food commodities are perishable and be consumed quickly or processed.
- The demand for the food products does not generally respond quickly to the price changes.i.e.Inelastic demand. This together with seasonal supply can mean that market prices vary considerably.
- There are a large number of small producers none of whom individually can influence market price.
- Natural factors such as bad weather, pests or diseases can affect the yield of the crop and output can never be fully under the farmer's control.
- Farm products are often of mixed quality due to bad weather or poor handling and therefore, fetch variable prices.
- Some agricultural products are very bulky, but of low value so that means transport costs as proportion of the value are high. It is better to process such crops locally e.g. cassava can be cut, peeled and dried before transporting.
- Many farmers are a long way from the market place thus incurring high transport costs.
- Once a given crop has been planted it is difficult to increase or decrease the resulting output.

THE COB WEB THEORY

This illustrates how prices of agricultural products can fluctuate because of the unplanned variations in supply and because of the difficulty of altering this supply in the short period, causing cyclical fluctuations in price.

- (i) Producers do not get discouraged or disappointed for good when the price falls but continue producing as they hope for better price.
- (ii) Produce is not stored and all output is sold at the ruling market price.
- (iii) Producers based their production plans on the ruling market price
- (iv) Producers never get wiser.

Divergent cobweb

Assuming farmers base their decisions of how much to plant on the price currently ruling in the market, if the present price is high, they will be encouraged to plant more and the vice versa. These plantings cannot, however, come straight onto the market but will only become available after the time needed for growth and transportation of the product to the market. This time taken is called a period .

The price reigning in a given period would then not affect the amount supplied in that period but will affect the amount supplied in the next period.

If S_t represents the amount supplied in period t then

$S_t = S(P_{t-1})$ where

S_t depends on the price reigning in the period $t-1$ just preceding it.

Assuming that at the start of the cycle there was supply OQ_1 below the optimum supply, the consumers would be forced to compete for the few commodities available on the market and so push the price up to P_1 .

If the producers based their plans on how much to produce on the expectation that the price would remain as high as P_1 , they would plan to produce a larger amount of produce, OQ_2 , in the second period. There would then be excess supply since the amount Q_2 is above the equilibrium quantity. For the producers to be able to sell off all their produce therefore, they would have to reduce their asking price to P_2 .

If the producers based their production plans for period 3 on the price remaining as low as P_2 , they would only provide quantity Q_3 to the market. This would cause a shortage and the excess demand created would push the price up to P_4 and so the process would continue.

The right hand curve of the figure shows the price ruling in the successive periods. The time is plotted on the X axis and the same vertical scale is used so that the prices can be obtained by horizontal extension from the left hand diagram.

Curve A shows a convergent cobweb that tends to the equilibrium. A convergent cobweb occurs when the price elasticity of demand is greater than the price elasticity of supply.

Divergent cobwebs move further and further away from the equilibrium and become wider over successive periods elasticity of demand.

A regular cobweb occurs when the price elasticity of supply is equal to the price elasticity of demand. It is an oscillation of prices between two points.

Effects of price fluctuations

- Unstable income to the farmers whose income depends on the price of the products that they sell. Farmers then cannot plan their output to meet their domestic expenditure and consumption.
- It discourages savings since the farmers are not sure of their next income. This discourages installation and establishment of capital assets.
- Since many developing countries depend on revenue from a few agricultural commodities, instability of price causes fluctuation in government revenue and thence its expenditure and purchasing power for imported goods.
- Price fluctuations, increase risks in production and thence increase the cost of production because they increase the necessity for insurance.
- Price fluctuations, especially the fall in prices, makes farmers unable to pay back borrowed capital promptly.
- Price fluctuation, put a severe strain on a country's balance of payments; forcing it to institute painful counter measure such as devaluation of currencies, import restrictions etc, all of which reduce the standard of living of the people. They also

- disrupt the development plans of the country or force a country to rely on foreign aid.
- They make government unpopular since peasants in developing countries tend to blame the government for the low prices.
 - They indirectly cause rural – urban migration as the youth try to flee the poverty stricken rural areas when the prices of agricultural products fall.
 - Unemployment arises in the agricultural sector and other related industries e.g. the agro based industries.
 - Declining prices forces government to subsidize the agricultural sector thus increasing government expenditure against the background of falling revenues. This increases the budget deficits.
 - They discourage production of the commodities whose prices have fallen. This may be a problem especially where the commodity in question is an foodstuff or a potential famine reserve crop.

Methods of reducing price fluctuations

- **Introduction of buffer stocks and price stabilization funds:** Buffer stocks are products kept in store and only released when there is an acute shortage likely to cause a big increase in price. Also, during bumper harvests, some of the products are withdrawn from the market and stored. This keeps the prices level. A price stabilization fund is money set aside to buy off excess supply of a commodity from the farmer at a fair price instead of allowing the price to fall excessively. Example of stabilization agencies include the National Cereals Board in Kenya and the strategic grain reserve in Tanzania, which stock maize and beans to ensure food security, and in the process help to stabilize prices.
- **Establishment of processing industries:** These improve the quality and longevity of the products. They also reduce the bulk of products and transportation to the market.
- **Establishment of proper transport infrastructure** to transfer the products from areas of plenty to areas of scarcity.
- **Diversification:** Farmers should be encouraged to produce more than one product such that fall in the price of one item can be compensated by revenue from another item so that the overall effect will be a leveling of prices and income.
- **Market diversification:** Measures should be taken to open up new markets to soak up the excess production.
- **International commodity arrangement** should be set up to monitor and regulate supply of the products and increase the bargaining power of the producers. They can also control the price of certain commodity on the world market e.g. the international commodity control scheme that was set up in 1945.
- **Industrialization:** This diversifies revenue for government and avoids over dependence on revenue from agricultural goods.
- **Technological and scientific innovations** within the agricultural sector to put up factors of production under more control and reduce the effects of natural

calamities. Quick maturing varieties also help to reduce the gestation period and increase the elasticity of supply.

- **Improvement of the quality of production:** Proper extension to farmers to increase the quality of their products reduces price instability since the price of high grade agricultural products tend to be more stable than those of low grade products.
- **Institutionalized:** Research and dissemination of market information: this helps study the market trends and make fairly accurate predictions on the position of demand and supply so as to adjust production accordingly.
- **Organization of marketing:** Farmers may organize themselves into cooperatives of government can set up marketing boards to bargain better and establish better marketing infrastructure.

Problems of implementing stabilization fund and buffer stock policies

- The stabilization fund delays efforts towards economic diversification since the farmers are protected from declining process and see no need to diversify.
- There is mismanagement, diversion and embezzlement of the funds.
- Government may lose money in the buffer stock policy since it will be directly involved in buying, storage and marketing of produce.
- A persistent decline in commodity prices will lead to exhaustion of the funds and eventual collapse of the stabilization scheme.
- The buffer stock as a stabilization policy can only work if the commodity in question can be stored for long without loss in quality.
- Farmer may try to benefit from high prices by hoarding the produce to create an artificial shortage. Farmers may also overproduce and flood the market making price control very difficult.
- Stabilization policies run counter to the IMF and World Bank of liberalization and free market economics.
- Collection of reliable and accurate statistical data on the supply and demand trends within and outside the country is difficult so making planning and coordination of the policy difficult.
- There may be inadequate crop finance to buy the produce from the farmers. There is then stiff competition from private buyers who may pay less in cash.
- For the policies to be successful there is need to find markets to eventually take the excess / stored produce.

International commodity organization

These are international cartels in which producers, and sometimes consumers come together and agree to regulate supply through the issue of quotas to raise market prices.

The role of commodity organizations

- They regulate supply through issuing of quotas and so raise and stabilize prices.

- They promote international cooperation and understanding among member countries.
- They undertake research to help promote the productivity, quality and consumption of the commodity.
- They have compensation scheme that offer balance of payment support to member countries with balance of payment problems resulting from price fluctuations, drought, wars etc.
- They improve the bargaining power of member countries, which improves their export earnings and terms of trade.

Conditions necessary for the success of commodity

- A small of producers to ease coordination, supervision and decision- making.
- Inelastic demand for commodity in question: the commodity should have no close substitutes and there should be no fears of being replaced.
- Harmony and common understanding among member countries.
- The commodity in question should not be perishable so as to be held off the market when prices are low.
- Solidarity and joint commitment to the term and objectives of the organization.
- Preferably, the producing countries should not be at the same level of development and have close, common interests.
- The elasticity of supply of the commodity in question should be low to ensure that supply is not increased easily when the prices go up and to check excessive supplies.

Problems of international commodity organizations

- It is not easy to supervise and enforce adherence to quotas.
- There is always a conflict of interest i.e. profit maximization versus utility maximization between producers and consumers respectively, and so reaching a consensus is not easy.
- There is a risk of sabotage from powerfully interest groups that could lose from such arrangements.
- They favour big producer that have bigger quotas and market shares at the expense of the small producers that cannot expand their output easily.
- Allocation of quotas is difficult since the criteria to be used are hard to agree on. Also some countries may fail to meet their quotas.
- Efficient producers with low production costs favour low prices to expand their sales while inefficient member cannot sell at low prices. Arrangement on the price may then be difficult and member countries may be tempted the legal restrictions.

Farm management

Management is the process of getting things done by and through people.

Management functions

Management involves distinct activities that can be called management functions. These include

- (iii) **Planning:** This involves deciding in advance what is to be done, when, why and by whom. Planning involves three distinct activities i.e. setting objectives, finding alternatives and selecting the best alternatives.
- (iv) **Organization:** This involves grouping of people and activities in their best possible relationship to get the work done effectively and economically and to help achieve objectives.
- (v) **Directing:** This is the giving of instruction on how and what should be done in which way.
- (vi) **Coordination:** This is the integration of activities of individuals to ensure coherence.
- (vii) **Supervision:** This is the observation of what is being done to ensure that it is consistent with the objectives.
- (viii) **Controlling:** This includes redirecting the course of something to ensure that the objectives are achieved and to prevent unsatisfactory results. Control prevents unauthorized action, keeps people informed of what is going on, forecasts results and predicts trends, enables the carrying out of remedial action and helps in future planning.

Tools of management control

- Profit and loss account
- Balance sheet
- Budgets
- Reconciliation bank accounts
- Inventory records
- Over due account statement.

- (ix) **Implementing:** This is the carrying out or execution of accepted plans.
- (x) **Staffing:** This is the identification and recruitment of the appropriate manpower to execute the tasks at hand.

The decision making process

To be able to make effective decisions the farmer has to go through a series of events

- (i) Identify the problem
- (ii) Collect all the information about the problem.
- (iii) Break down the problem into achievable and measurable alternative.
- (iv) Identify the working alternatives
- (v) Collect all the information on the alternatives
- (vi) Evaluate the alternatives
- (vii) Choose the best alternative
- (viii) Implement the best alternative
- (ix) Monitor and collect data on the performance of the chosen alternative.
- (x) Evaluate the performance of the alternative.

- (xi) Modify the alternative according to its performance.

Efficiency in farming:

This is a measure of the physical and (or) financial performance of a farm. It helps the farmer to identify his weakness and strengths and so enables necessary improvements to be made.

Efficiency standards:

These are measures or guidelines used to compare the performance of a farm. There are several types of efficiency standards i.e.

Technical efficiency: Is a measure of the physical output per unit of input. It compares the output of the farms of the same size, type and locality.

Economic efficiency: This compares the yield obtained with the average expected yield obtained through research.

Partial efficiency standards: These assess the efficiency of carrying out a particular farm enterprise and do not measure the efficiency of the entire farm.

$$\text{Yield index} = \frac{\text{Actual yield} \times 100}{\text{Expected yield}}$$

System index: The yield of a particular enterprise is compared with that on a similar farm. For example the number of eggs from 100 layers on farm A is compared to farm B.

$$\text{System index for farm A} = \frac{\text{yield on farm A} \times 100}{\text{Yield on farm B}}$$

$$\text{Overall efficiency} = \frac{\text{profit obtained} \times 100}{\text{Capital}}$$

Factors influencing efficiency in farming:

Price: The prices of the products and the prices of inputs affect the efficiency of the farmer.

Managerial ability of the farmer i.e. ability to make sound production decisions, ability to carry out agronomic practices on time etc.

Size of the farm: Under good management, the bigger the farm, the more the returns for each unit of land, labour and capital utilized. This is because in large-scale production a farmer benefits from economies of scale.

Records kept: Farm records enable farmers to know the economic situation of their farmers. They also enable the farmers to know the best enterprises to pursue.

Climatic conditions: The better the climate the higher the efficiency because the yields and returns will be higher.

Health of the farmer: The healthier the farmer the higher the efficiency since he can do more work and supervise better.

Crop and animal pests and diseases: These reduce the yields and therefore the efficiency of the farmer.

FARM RECORDS

This is information stored for future reference.

Importance/ advantages

- Help the farmer in planning and making decisions.
- Enable the farmer to know if he/she is making profits or losses.
- Help farmer to obtain loans.
- Help the farmer to improve by showing the areas of weakness.
- Enable the farmers' taxes to be assessed correctly.
- In co-operative farming, records help in sharing profits and losses.
- Act as incentives to the farmers as they show his progress.
- Show the history of the farm and its development.
- Help the farmers to cull unproductive animals.
- Show the financial stand of the farmer.
- Help in valuing the farm in case of sale.
- Health records enable the farmer to control diseases.
- Show the farmers' income and expenditure.
- Help in breeding by showing an animal lineage/percentage.
- Show whether farm plans are being operated correctly.
- Show the efficiency of a farmer/used in calculating the efficiency of a farmer.
- Are legal requirement in certain countries.
- Help in settling the estate in case of death.
- Help the farmer in making insurance claims.

Types of farm records:

There are several types of farm records each with a variety of items.

- Crop records showing items such as type and quantity of crops grown, yield, agronomic practice etc
- Labour records showing the amount and costs of labour used.
- Production records e.g. number of livestock kept, amount of milk, beef, eggs produced etc
- Calving records showing data of calving, weight of the calf, condition of the calf etc
- Health records to show diseases incidences, treatment given,
- Breeding records to show items like parentage date of service, breed, sire and dam etc.
- Financial records to show items like profits, losses, total sales, daily income etc
- Records on farm history.

- Inventory; a list of all physical properties on the farm.
- Feeding records to show the amount of feeds given daily, type of feeds etc.

The trading account (profit and loss account)

This shows the income and expenditure incurred on the farm during a stated period of time, usually one year. It also show how the inventory changed (crop, supplies and livestock) during the same period of time and the estimated depreciation on all the depreciation assets i.e. buildings, machinery, and equipment.

The structure of the profit and loss account is as follows:

(i) Opening valuation +	(ii) Closing valuation
<u>Purchasing and expenses on debt side</u>	<u>Sales and receipts on credit side</u>

E.g. use the following information to construct a profit and loss account for Mr.waiswa s mixed farm for the year ending December 31st 1976

Sales of poultry	500
Opening valuation	12000
Purchase of seed	280
Purchase of fertilizers	200
Rent	200
Sales of grain	1200
Sales vegetables	50
Closing valuation	10000
Hired labour	250
Depreciation	50
Interest on loan	40
Repairs and maintenance	130
Purchase of chicken	80
Sales of milk	600
Purchase of calves	100
Purchase of feed stuffs	250
General expenses	100

Note:

- (i) There is a heading, starting the duration on the account.
- (ii) Purchase and expenses are entered on the left side while sales and receipt are entered on the right side.
- (iii) Expenses or receipt on individuals item summed up and entered as a total.

- (iv) The value of all items on the farm at the beginning of the year is entered as opening valuation under purchases and expenditure. If the farmer had to buy the farm at the beginning of the year, that would be his expense.
- (v) The value of the assets on the farm at the end of year is known as the closing valuation. These are entered on the sales and receipts because if the farmer sold off his farm at the end of the year, this is the amount he would receive for it.
- (vi) There is a net profit or net loss. A net profit when sales and receipts exceed the purchase and expenditure and a net loss when the reverse is true.
- (vii) When trading account is complete, both sides have to balance. The net profit always appears on the purchase and expenditure side while a net loss appears on the sales and receipts side.

Mr. Waiswa's trading account for the year ending 31st Dec. 1956

Dr: purchase and expenses		Cr: sales and receipts	
Opening valuation	12000	Closing valuation	10000
Seed	200	Poultry	500
Fertilizer	200	Grain	1200
Rent	200	Vegetable	50
Labour	250	Milk	600
Depreciation	50		
Interest on loan	40		
Repairs and maint	130		
Chicken	80		
Calves	100		
Feeds	250		
Expenses	100		
Total expenses	13680	Total sales	12350
	13680	Net loss	1330
			13680

Exercise

To construct a profit and loss account for Beta farm enterprises for year ending 1987 using the following information.

Sales cattle	400,000
Sales of milk	1,000,000
Purchase of drugs	125,000
Sales of beans	400,000

Purchase of cattle	700,000
Wages to workers	1,500,000
Sales of cabbages	700,000
Debt payable	400,000
Purchase of fuel	396,000
Purchase of seeds	30,000
Opening valuation	2,000,000
Debt receivable	300,000
Rent for land	90,000
Purchase of poultry	600,000
Closing valuation	2,420,000
Purchase of feeds	405,000
Sales of culls	800,000

The Balance Sheet

This is a statement drawn up to show the financial stand of the farmer on a particular date. It shows the liabilities and assets of the farm on a particular date.

Liabilities: These are the debts and obligations i.e. all that the farm should pay to other people. They include

- (i) Loans
- (ii) Money that the farmer has to pay out but has not yet paid i.e. debts payable.
- (iii) Overdraft at the bank.
- (iv) Depreciation (the loss of value of a commodity with time).

Liabilities appear on the **Left** hand side of the balance sheet.

Assets: These are the items on the farm and their value. Assets include

- (i) The value of machinery, crops, livestock, equipment, houses etc.
- (ii) The money that the farmer hopes to get from goods sold but not yet paid for. This is known as debts receivable.
- (iii) Any prepaid expenses i.e. any goods or services paid for but not yet delivered.

Assets appear on the **Right** side of the balance sheet.

The totals on both sides of the balance sheet must balance.

Where the value of the assets is greater than the liabilities, the difference, called the Net worth or net capital is recorded under liabilities i.e. that would be the money the farm owes the farmer.

If the liabilities are greater than the value of assets, the difference is recorded under assets. The farmer would then be said to be bankrupt, that is, even if he sold off all his properties; he would not be able to pay off his debts.

e.g. to construct a balance sheet for Alpha farm as at 31st/ 12/ 1997 using the following information:

Cash in bank	8,000
Bank overdraft	15,000
Debts payable to Coop. Union	15,000
Debts receivable	2,000
Value of land	40,000
Value of sheep	5,000
Value of cattle	20,000
Value of coffee	45,000
Long term loan	50,000
Value of buildings	45,000
Value of machinery and implements	35,000

A balance sheet for Alpha farm as at 31st/ 12/ 1997

Liabilities

Assets

Overdraft	15,000	Cash in Bank	8,000
Debt payable to coop.	15,000	Debts receivable	2,000
Long term loan	50,000	Value of land	40,000
		Value of sheep	5,000
		Value of cattle	20,000
		Value of coffee	45,000
		Value of buildings	45,000
		Machinery and implements	35,000
Total liabilities	80,000	Total assets	200,000
Net capital/ worth	120,000		
	200,000		200,000

To construct a balance sheet for scudeto farm as at 31st Dec. 1996 using the following information

Value of implements	1,250,000
Debts payable	320,000
Value of crops	300,000
Value of livestock	300,000
Bank overdraft	1,450,000
Cash in bank	288,000
Debts receivable	462,000
Depreciation	60,000

Value of buildings	2,000,000
Pre-paid expenses	600,000

Benefits of balance sheets:

- They enable farmers to acquire loans as they show the worth of the business.
- They help in assessment of the value of the farm in case of sale.
- They enable the sharing of profits and losses.
- They enable companies to negotiate for mergers, contracts etc.
- They are a legal requirement for public companies and have to be published annually.

Farm budgeting

A budget is an estimate put on paper to determine the economic results of changes in costs and returns over a given period. It is a document which shows firms' expected income and expenditure.

Types of budgets

There are two types of budgets that can be drawn up, a partial budget and a complete budget. If the farmer wants to make a small change involving only a small portion of the farm or a few enterprises, a partial budget is used. On the other hand, if there is a major change, a complete budget is necessary. In either case, gains have to be compared with losses.

When making a budget, the following considerations have to be made/ taken into account.

- **Least cost combination of the factors of production used on the farm:** Resources should be allocated so that the highest returns are obtained from their use.
- **Opportunity cost:** Several budgets may have to be made to determine the most appropriate alternative.
- **Expectations through time:** Expected future changes should be taken into account.

Aids to budgeting

The farmer may use some of the following information in making the budget.

- (i) **Results from controlled experiments or research stations:** This may however have some drawbacks e.g.
 - Such results may not include an economic component e.g. the data will show the expected yields but not the production costs.

- Production under experimental conditions is often much higher than under normal conditions.

(ii) **Data concerning the input-output relationship:** This also has some shortcomings namely that;

Some products are joint and share inputs and costs that are difficult to separate e.g. hides and beef.

Production resources are not uniform and vary from farm to farm; soil fertility, types of capital and even management may vary substantially in different locations.

The figures may not be accurate since they depend on how well the farmer can recall. If the amount of inputs used and the yields are continuous through out the year or part of the product is used at home then the problem becomes even greater.

(iii) **Data on the prices of inputs and products;** Generally the prices of the inputs are more stable than the prices of products. Such information may be obtained from the various manufacturers of agricultural inputs and a survey of the market prices. Present product market prices should however be projected into the future to get an accurate budget.

(iv) **Farm records;** If they are well kept, they can enable the farmer to make very accurate budgets. The gross margins of various enterprises are particularly important.

If added receipts plus reduced costs are higher than added costs plus reduced receipts, then the change is profitable. If the reverse is true then the change can only lead to losses.

In comparing two enterprises, which the farmer may wish to substitute, the gross margins of the enterprises are compared. The one to be replaced is placed on the losses side while the one expected to be embarked on is put on the gain side. It is however important to include changes in fixed costs.

Constraints to budgeting

- (i) The farmer may not recognize supplementary or complementary enterprises, which could be produced without too much added costs.
- (ii) The farmer may not have much imagination so as to take care of future changes in prices, tastes etc.
- (iii) There may be lack of technical information and so unused resources may not be recognized.
- (iv) The farmer's interest in optimizing returns may not be sustained for the entire financial year.

How to make a Budget:

Identify your needs.
Identify your resources.
Cost each of your needs.
Arrange your needs in order of priority.
Find the alternative means of satisfying your needs.
Choose the best alternatives.
Allot the resources to the priorities.
Write it out as a draft.

AGRICULTURAL CREDIT

This is borrowed capital used by farmers to finance their activities. It is credit in cash or kind extended to the farmers.

Types of credit

Credit may be classified as short term, medium term and long term.

Short term credit: This is intended for working capital .i.e. Buying fertilizers, seeds, sprays, fuel, feedstuffs, hiring machinery or labour etc. it is normally repayable within a year.

Medium or intermediate credit: This is used for minor land improvements e.g. fencing and purchase of machinery of machinery and livestock. It is normally repayable over 2-15 years.

Long term credit: This is normally used for purchase of land or major improvements on the land e.g. soil conservation work and land reclamation. It is normally repayable over 15 – 30 years.

Capital may be also be classified as hard or soft credit. Hard credit is that given against substantial security, usually immovable assets such as machinery.

Sources of credit:

- Commercial banks.
- Cooperative banks.
- Cooperative societies.
- Crop board e.g. the coffee development authority.

- Government through schemes e.g. Entandikwa.
- Societies e.g. burial.
- Micro finance institutions e.g. PRIDE, FINCA, women's trust etc.
- Licensed money lenders.
- Informal credit borrowed from friends or relatives.

Benefits or use of agricultural credit

- (i) It enables farmers to finance their activities through out the production season e.g. paying salaries and wages.
- (ii) It improves capital for building up an enterprise.
- (iii) It enables farmers to cope with seasonal patterns of production e.g. there are seasons when the farmer is harvesting and hence could have some income and other seasons when the farmer could have no income.
- (iv) It enables farmer to purchase land or grade animals.
- (v) It enables the farmer to finance purchase of current input e.g. seeds, drugs, etc to increase production.
- (vi) Capital may be for consumption e.g. for construction of family buildings.
- (vii) It may be used to improve transport e.g. by purchasing trucks.
- (viii) It may be used for land registration.
- (ix) It may be used for construction of stores.

Categories of credit:

- **Consumption credit;** this is used to cater for the living expenses of the family.
- **Cultivation finance:** this is used for buying production inputs e.g. seeds, fertilizers, and insecticides. It is often short term and is often provided in kind.
- **Crop finance:** this is used for buying produce. It is acquired by cooperatives from banks or directly from government.
- **Development finance:** this is used for introduction and expansion of farming and processing operations e.g. establishment of ranching schemes, purchase of ginneries, coffee pulperies, crop driers etc
- **Commercial finance:** this is used for promotion and sustenance of commercial activities e.g. Transportation, advertisement etc.

Interest

This is the fee charged for use of borrowed capital. It is calculated as a percentage of the total credit (principal) and usually paid annually.

Factors affecting the interest rate

- **Demand for credit:** the higher the demand, the higher the interest rate.
- **Supply of the loan able money:** the higher the supply of money that can be lent out, the; lower the interest rate.

- **Cost of administration:** the higher the costs of administration, the higher the interest rate.
- **Losses due to default:** the higher the losses due to default the higher the interest rate because the bank would want to recover their money and also because the loan would then be classified as risky.
- **Decline in the value of money (depreciation):** the higher the rate of depreciation in the economy, the higher the rate of interest.
- **Interest paid on the deposits that finance the loans:** most loan able money is actually from deposits of people who save with the bank or financial institution. This money has to accrue interest for the depositors.
- **Government policy:** government may cause a rise or fall in interest rates through raising or lowering the interest rate at which it lends to the banks.

For a particular loan, the interest charged would depend on.

- Size of the credit.
- Type of credit i.e. whether short term or long term.
- Credit worthiness or collateral security of the borrower.

Loan application

All information concerning the loan should be gathered and sent to the loan agency. The application form should show the following

- (i) **Personal data** i.e. name, family status, list of dependants and permanent address.
- (ii) **Economic status** i.e. type of business, size of the farm, location of the farm, land tenure and the crops cultivated or the animals kept.
- (iii) **Loan requirements** i.e. the amount required, period of payment, purpose of the loan, security offered etc.

All information should be confidential.

Assessment of loan applications

Assessment is an economic appraisal of the loan application. It must cover the following;

- (i) The economic situation of the farmer i.e. compares his assets and his liabilities.
- (ii) The purpose of the loan: production loan are usually give priority over consumption loans.
- (iii) The purpose of the loan in relation to the requested amount. The amount should be appropriate to the purpose of the loan. Insufficient credit will endanger the success of the project while excess credit will lead to wastage of funds. Also the period of repayment of the loan should be related to the purpose of the loan. The duration of the loan should be adjusted according to the purpose of the loan and the liquidity of the applicant.

- (iv) The intended contribution of the farmer to the project: the loan is easier to give to a farmer who has a substantial stake in the project.
- (v) The security offered / collateral: the collateral offered should be equal or greater in value than the loan requested for.
- (vi) Previous loan history: loan agencies are more reluctant to lend money to new clients than they are to lend money to those they have previously dealt with on loan issues.

Why farmers sometimes fails to repay their loans

- (i) **High interest rates:** these make the amount to be repaid by the farmer much higher than the profits that the farmer may make from the use of that loan.
- (ii) **Inflation:** this may erode the value of the loan money making it both unable to cover the intended job and also very hard to pay back especially if the loan was quoted in foreign currency that appreciates as the local currency depreciates.
- (iii) **Failure of production e.g. of crops or livestock:** the farmer's venture may fail e.g. due to bad weather, pests and diseases etc
- (iv) **Fall in price / poor market:** the farmer may produce and yet fail to find the anticipated market due to changes in tastes, falls in price etc
- (v) **Unsuitable conditionalities attached to the credit:** some credit conditions attach unpalatable restrictions on the usage of the credit and so restrict the farmers' flexibility in respect to market conditions.
- (vi) **Unrealistic repayment schedules:** the loan period may be too short or too long making the farmer overloaded in repayment of the loan.
- (vii) **Political instability:** this may lead to destruction of the farmer's assets and make it very hard for the farmer to produce thus rendering him incapable of repaying the loan.
- (viii) **Poor culture of loan repayment:** many African farmers have a poor attitude towards loan repayment and do not want to repay even when they are able to.
- (ix) **Low level of education of the farmer hence low powers of negation and poor record keeping:** this makes it difficult for the farmers to know whether they are making profits or losses and so make adjustments.
- (x) **Poor extension services and so poor choice of business venture:** the farmer therefore make the wrong business decisions and so are not able to make enough profit to serve the loan.
- (xi) **Miss appropriation or miss use of the loan:** many farmers miss appropriate the loan especially if it is in cash e.g. a farmer may use a loan intended to boot production for marrying another wife.
- (xii) **Inadequate credit:** the credit may not be enough to cover the entire production process. The farmer may then not be in position to implement his production plan to his satisfaction.

Measures to make agricultural credit more effective

- (i) Agricultural credit should be offered as part of an integrated agricultural development programme. The programme should include extension services to advise farmers to how to use the loans. The extension worker should help farmers choose viable venture that are manageable by the farmer. Credit programmes must be accompanied by measures to develop a commercial attitude to farming and definite encouragement of saving in the farming sector.
- (ii) Agricultural credit in developing countries must be sponsored by government primarily as a public service and an investment for agricultural development rather than as a banking business enterprise. This is because many commercial banks shun lending to agriculture because it is too risky
- (iii) Training programmes for agricultural credit personal, cooperative societies staff and supervisors should be provided regularly to enable them handle farmers appropriately.
- (iv) Where possible and necessary agricultural credit to inexperienced farmers should be given mainly in kind.
- (v) Agricultural credit institution should have an active credit policy that takes the credit to the farmer rather than waiting for the farmers to come to them. This is to increase awareness of the availability of credit and to help overcome the conservativeness of the farmers.
- (vi) Security demanded by the credit institutions should be within the farmers means. Insistence on immovable assets as security is likely to limit the facilities to the relatively wealthy. Credit should therefore be soft.
- (vii) All agricultural credit institutions in the country should work together and coordinate their activities to avoid duplication of effort. They should monitor their work a view to identifying their strengths and weakness and so improving the credit system.
- (viii) Government should provide other services such as adequate transport and communication infrastructure, security, health services etc. to compliment agricultural credit programmes and ensure success of the credit programme.
- (ix) Credit institution should ensure regular visits to the farmers to supervise the utilization of the loans.
- (x) Loan recovery programmes should be instituted and properly enforced to cut down on defaulting.
- (xi) The interest charged by the lending institutions should not be high encourage farmer borrow money.
- (xii) Give loans to the farmers in time. The paper work should be kept a minimum on order to save time.
- (xiii) There should be moves to ensure provision of inputs to the farmers at fair prices.
- (xiv) The marketing of farmers produce should be improved to be able to dispose the increased output that will arise from the increased supply of capital.
- (xv) The credit institutions should give a reasonable grace period to the farmers and also give a suitable loan repayment schedule to farmers.
- (xvi) Where possible the credit to be given to the farmer can be given in the relevant portions at specific times.

Subsidy schemes

A subsidy is a aid to sustain or supplement business. They may be in form of reduced prices for inputs or payments of an amount of money over and above the market price of the output, usually by the government. Subsidies are incentives to farmers and are often applied discriminately.

Importance of subsidy schemes

- They stabilize the prices of agricultural products and stabilize farmers incomes.
- They encourage people to invest in rural areas and so reduce movement of people from moving away from rural areas.
- It may influence the pattern of investment towards the subsidized product.
- The subsidy may stimulate the improvement of or initiation of the use of complimentary natural resources e.g. a successful fertilizer subsidy programme will increase yields and so make it necessary to improve on storage, transport and marketing facilities thus stimulating them.

LAND TENURE

This refers to the possession of rights to the use of land.

Systems of land tenure:

Private ownership: (also called freehold, landlordism or individual ownership).

An individual owns the land and can get a title for it. He may allow other people (tenants) to settle on his land. Such people pay rent to the landlord e.g. Mailo land in Buganda.

Advantages of individual land ownership:

- It is an incentive to farmers to improve the land
- It settles/avoids demarcation and inheritance disputes
- Land consolidation and farm planning become easier
- It safeguards the position of the local community if land is in short supply
- If the holder has a land title, he can use it to get a loan

Disadvantages of individual land ownership:

- Since the land can be sold and bought at will, tenants may be turned out with no means of livelihood.
- It encourages the hoarding of land.

Leasehold:

Government is the sole owner of the land. Land is given to a tenant/individual for a specified period of time and the tenant pays rent for the land. The lease is usually effective for a long time e.g. 49, 99 and 999 years.

State ownership:

Here the land belongs to the state and no one has a right or title over the land. Individuals can be allowed to settle in an area but they can be evacuated at any time e.g. crown land in Buganda.

Communal ownership/customary land tenure:

Land does not belong to individuals but to easily define sections of the community such as a clan. Every member of the clan has a right to the use of land but the land is neither bought nor sold.

Advantages of communal ownership

- Every member of the community has access to the land.
- There is no hoarding of land i.e. unused land is re-allocated by the community.

Disadvantages of communal ownership

- There is no incentive to the farmer to improve land.
- There is no overuse of the land i.e. overstocking, overgrazing etc.
- It is not possible to use this land as a security to obtain loans.
- There is land fragmentation due to over population.
- Over cropping is experienced in areas of high population pressure.
- It limits new/modern-farming techniques.

Co-operative land tenure:

Land is owned by a group of people who organize themselves into a co-operative society. All the people in the group have a title deed jointly.

LAND FRAGMENTATION

Is where a farmer has several small pieces of land instead of one large piece of land.

Cause of land fragmentation

- Shifting cultivation that makes it inevitable for the farmers to have small plots that they can conveniently clear and look after. Traditional systems of inheritance where each heir is entitled to a share of the parents' land.
- Increasing population pressure on a limited amount of land.

- Accumulation of land as in the case of farmers with limited capital who wish to increase their land holdings, purchasing small pieces of land in different places and at different times.
- Poverty: Lack of money to buy large chunks of land.
- Communal land tenure system where farmers can not command large chunks of land since each member of the community is equally entitled to the same plots of land.

Disadvantages of land fragmentation

- Movement from one plot to another wastes the farmers' time.
- It makes mechanization difficult due to the frequent necessity of turning in the small plots and the high expenses of fuel in driving to far off plots. This generally reduces the productivity of the land.
- There is no efficiency in farming e.g. fencing cannot be carried out.
- Farm planning cannot be carried out easily.
- The farmer cannot easily restrict his grazing and this encourages communal grazing and its attendant problems of overgrazing and soil erosion.
- Weeds, pests and diseases are difficult to control because the farmer's holdings are heavily surrounded by other people's holdings. The neglected blocks nearby that belong to other people may act as sources of re-infection.
- Agricultural extension is not very easy to carry out because farm operations cannot be centralized.

LAND CONSOLIDATION

Is the pooling together of small pieces of land so that the farmer has one large piece of land instead of many small plots.

Advantages of land consolidation:

- It saves a farmer's time since movement is avoided.
- It makes mechanization easy and so can increase farm productivity.
- It makes farm planning easy.
- It increases efficiency in farming e.g. fencing can easily be carried out.
- It reduces theft of farm produce.
- It makes storage of farm produce easy.
- It makes the provision of extension services easy since the farm can be well planned and the farm management can easily be centralized.
- Control of pests, diseases and weeds is easier since the farmer can restrict his activities and enclose them by fencing economically and so reduce the spread of weeds, pests and diseases from the surrounding neighbours.

LAND REGISTRATION:

Is the process of getting an official document from the government called a Title Deed to establish ownership.

Advantages of Land Registration:

- (i) There is security of tenure.
- (ii) The farmer can use the land as a security to obtain a loan.
- (iii) It solves/ avoids ownership and demarcation disputes.
- (iv) The occupant can lease part or all his land and get extra income.

How to obtain land for farming:

- By buying
- By renting
- By inheritance
- By joining co-operative society
- By borrowing/ begging from a landlord.

Land settlement

This refers to the planned transfer of a population from one area to another.

Settlement strictly refers to the transfer of people to an area that has been previously inhabited.

Resettlement refers to the process of transfer of people from densely populated areas to sparsely populated areas.

Objectives of settlement schemes in Uganda

- (i) To relieve population pressure and allow every one to have enough land for cultivation e.g. the movement of people from South Kigezi to the less crowded areas of Bunyoro and Ankole.
- (ii) To prevent reinfestation of tsetse flies into areas that had been cleared of them. The resettlement was to act as a barrier to prevent land from going back into bush e.g. in South Busoga.
- (iii) To facilitate mechanization: large group farms were set up to enable a nucleus of people unite in one economic activity so that they could pool resources i.e. land, tractors and other equipment for use economically.
- (iv) Ease provision of services e.g. education, electricity, water etc to people in a group other than those scattered.
- (v) To assess the technical feasibility and economic returns from the development of a substantial area of irrigated farm land i.e. for experimental purposes e.g. the Mubuku irrigation scheme.
- (vi) To resettle the displaced: some were set up to provide a temporary home to the refugees from disturbed countries or parts of the same country e.g. the Agro refugee settlement in northern Uganda.

Factors to consider before establishing a settlement scheme

(i) Planning should be done in advance and should take account of the following

- Purpose and objectives of the scheme which should be set out clearly
- Data related to the physical and climatic factors should be analyzed objectively
- The environmental requirements of and the suitability of the proposed enterprise
- Social economic structures, market access and communication
- Expected number and origin of the prospective settlers
- Social and cultural characteristics of the settlers e.g. their farming experiences, traditional values and attitudes of farming etc.

(ii) A feasibility study should be carried out to show

- The value added to the national economy
- Increase in income to the farmers resulting from the scheme
- The value added to the national economy
- The increase in revenue to the government
- For a scheme to be successful it must ensure that the farmers earn an income high enough to reward them for their efforts and compensate them for the disruption of their activities caused by establishment of the scheme.

- (iii) **Selection of the settlers:** the settlers should have genuine interest in participating in the scheme. They should know the objectives of the scheme and if possible they should be involved in the actual planning.
- (iv) **Land holdings:** these should be viable both at the time of establishment and also have potential for future development.
- (v) **Land tenure:** the ultimate land tenure arrangement in the programme must be specified. If doubts are allowed to prevail, settlers' initiative will be crippled.
- (vi) **Supporting services:** agricultural extension services, financial credit, market facilities, training facilities etc should be available to the settlers.
- (vii) **Efficient communication:** good roads should be established. Settling people in isolated areas away from the main population centers and the mainstream of a country's economic and social life should be avoided. Settlers should be allowed to live a community and forge links among themselves and lead an active and harmonious life.

Agriculture research stations and training centers

Research stations carry out the following

- Development of new crop varieties through breeding.
- Improve the existing crop varieties.
- Testing of new varieties to determine how they perform in local conditions and certification of seeds.

- Comparing two or more varieties to observe their performance in a particular environment.
- Soil testing and determination of optimum fertilizer requirement.
- Finding the best methods of protecting crops against pests, diseases and weeds.
- Evaluating and testing chemicals for use with crops and animals.
- Testing new farm machinery to observe its performance in local conditions.
- Developing new farming machines or improving the existing ones.
- Improving livestock through breeding.
- Finding ways of preventing and treating diseases in farm animals and crops.
- Finding ways of reducing crop losses e.g. through preservation and processing, better storage techniques etc.

All information from the research centers reaches the farmers through extension agents. These are agricultural specialists who

- Study what researchers have found out.
- Interpret the research results.
- Present research innovations to farmers in a way that farmers can understand and use.

Extension workers use demonstration, talks, meetings film shows, personal contacts etc. The research centers in Uganda include Kawanda and Namulonge for the central and southern parts of the country and Serere for the northern and eastern parts of Uganda. Also Namalere research station, which is specific for agricultural mechanization i.e. testing farm implementations and tractors while Entebbe breeding center for animal breeding, exist.

FARMING ORGANISATION

COOPERATIVES

Are business organizations formed by people to provide goods and (or) services for themselves. They are owned and controlled by the people who form them.

Cooperatives principles

These are the guidelines on which co-operatives operate. They include:

- (i) **Open membership:** Membership is open to anyone of good character.
- (ii) **Voluntary membership:** joining a co-op society must not be forceful.
- (iii) **Democratic control:** All members must have equal say i.e. one man one vote. Management is done by elected officials.
- (iv) **Capital shares:** to become a member, one has to buy shares.
- (v) **Limited interest on share capital:** A member's share capital should carry as little interests as possible because the principle aim is goods and services not high returns.
- (vi) **Equitable distribution of profits:** Profits are paid according to the volume of trade each member has conducted through the society.

- (vii) **Promotion of education:** Co-operatives should promote the education of their members.
- (viii) **Cash dealings:** Dealings of a co-operative should be strictly at cost.
- (ix) **Neutrality:** A co-operative is neutral in politics, religion or ethnicity.
- (x) **Continuous expansion:** A co-operative has continuous expansion in terms of membership and physical facilities.

Types of cooperatives

- (i) **Consumer cooperatives:** These distribute goods to the consumers at the minimum possible price.
- (ii) **Saving cooperatives:** These encourage members to save and to obtain loans.
- (iii) **Producer cooperatives:** These are owned and operated by producers to collect, process, transport and market their products.
- (iv) **Marketing cooperatives:** These collect produce from growers and transport and market it.
- (v) **Building societies:** These mobilize savings and distribute loans to the members for construction of decent houses and other productive investments e.g. the alliance building society, Uganda building society etc.

Benefits / objectives / advantages of co- operatives:

- Farmers can produce and market their commodities at low cost because they benefit from the economies of large scale.
- Farmers can obtain goods and services at lower cost due to discounts of bulk purchasing.
- Farmers can get credit facilities from the co-op.
- Farmers can get better prices for their products due to collective bargaining.
- Members have easy access to agricultural inputs.
- They eliminate middlemen whose profits increase the prices in trade and commerce. These increase farmers' profits.
- They increase rural infrastructure development since they would encourage setting up of roads; stores etc to handle the farm produce.
- They reduce urban migration as the rural areas become better developed.
- They give incentives to the farmers to produce more due to the increased market and higher incomes.
- They make transportation and marketing of produce easy.
- They provide storage facilities for the farmer's produce.
- They provide agricultural information to their members as regards crop production, livestock rearing, marketing, accounting etc.
- Members share some overhead costs e.g. depreciation on machinery, house rent and permanent labour.
- They increase the standard of living by increasing the education, income and employment in the rural areas.
- It enables the pooling of machines and other equipment for more effective utilization.

- Due to provision of storage facilities and capital, they reduce price fluctuations by buying and storing the excess produce and later remitting some of the profits to the farmers.
- It creates the spirit of communal work in the rural areas, which increases the total output of the producers.
- Individual members are able to participate in business and are therefore exposed to commercial life.
- Savings co-ops encourage farmers to save.
- They lobby the government on farmers' interests.

Problems of Co-operatives in East Africa

- Illiteracy of most of the farmers, which makes their participation difficult.
- Inadequate finance which makes the cooperatives unable to pay promptly for farmers' produce and so making them easy to out-compete by private buyers.
- Lack of basic infrastructure e.g. roads and railways, which hampers transport and communication.
- Inadequate storage facilities which hampers purchase and storage of the products.
- Mismanagement by the administrations.
- Government interference in the running of societies, which encourages favouritism and nepotism.
- Political instability, which lowers the ability to produce and destroys infrastructure.
- Low interest paid on share capital which discourages investment in the co-operatives.
- Fluctuating of most of the products' prices on the world and local market that discourages production.
- Competition from private buyers / producers of goods and services who may offer better terms.
- Seasonality of most of the products dealt in and yet officials are paid throughout the year.
- Bureaucracy, which slows down decision-making.
- The monopoly powers sometimes given to co-operatives by governments encourage inefficiency.
- Provision of grants and subsidies to the co-operatives also encourage inefficiency.
- The existence of statutory marketing boards deprives the co-operatives of business.
- Co-operatives often deal in specific products and so lack flexibility and initiative.
- Lack of transport: most co-operatives do not have enough vehicles to transport farm produce.
- Disloyalty of the members: there is delay in repayment of loans or paying up of share capital.

- Delay in payment for farmers' produce due to bureaucracy and lack of ready finance.
- Lack of capital personnel due to the low salaries / wages usually paid.

Solutions to the problems of co-operatives in East Africa:

- Carrying out seminars and in service courses to improve on the management.
- Education of the farmers to ensure that they can adequately participate in the running of the cooperative.
- Fighting political instability, sectarianism and tribalism to ensure that appointments are made on merit and that there is no in fighting in the cooperative.
- Encouraging diversification to ensure that the infrastructure owned by the cooperative is not idle for part of the year.
- Giving credits to co-operative societies to enable them purchase farm produce and finance their other operations.
- Building the necessary infrastructure to enable the cooperative transport the produce to the storage or market centers.
- Providing transport facilities e.g. Lorries to enable the cooperatives transport the produce economically.
- Giving storage support programmes e.g. building large stores for the societies.
- Facilitation of the farmers to interact with others farmers through trade fairs, conferences etc.
- Provision of extension services to increase the quantity and quality of farm produce and so ease its marketing.
- Subsidizing farm inputs supplied through the co-operatives to make them relevant to the farmers since they would be able to get inputs at prices lower than the market prices.
- Expansion of markets both local and external for broader markets of farm produces e.g. through PTA and COMESA.
- Strict anti-corruption legislation to reduce corruption and embezzlement of co-operative finance.

Factors necessary for co-operatives to succeed

- Adequate funds or finance.
- Adequate volume of business.
- Clear goals and objectives known to all members.
- High level of entrepreneurship ability.
- No interference especially from government.
- Some amount of goodwill from all members.
- Political stability / security to facilitate production.
- Some high level of education for all members to create equality.

MARKETING BOARDS

Are organization set up and controlled by government / statute to buy specific commodities from the producers, process them and resale them.

Marketing boards were mainly set up after world war two because of the following:

- The need to establish producer prices after the fluctuation during the war.
- To promote the expansion of cash crops e.g. cotton and coffee in Uganda and so reduce dependence on one crop.
- To strengthen the bargaining position of the farmers due to collective bargaining.
- To increase state participation in economic affairs.

Advantages of marketing boards

- (i) They cushion the farmer against the effects of price fluctuations as they usually operate at fixed price.
- (ii) They encourage production by giving price guarantees.
- (iii) They remove the exploitation of farmers by private dealers who may pay less to the farmers.
- (iv) They help to control quality of they produce.
- (v) They ease tax collection by government since they collect all the produce and the tax is collected at one point.
- (vi) They are in a better position to look for external markets than individuals farmers.
- (vii) They offer specialist or technical services which an individual farmer could not pay for.
- (viii) They can enforce quarantine measures against pest and disease out break when necessary.
- (ix) They provide planting materials and inputs e.g. seeds or seedlings, pest sides, fertilizers etc.
- (x) They stabilize the flow of essential foodstuffs by string when in excess and selling later.
- (xi) They are in better position to buy produce in remote rural areas where demand is restricted.
- (xii) They carry out ventures e.g. research that the individual farmer may not afford.
- (xiii) They reduce the farmer s marketing costs to the farmers advantages.
- (xiv) They offer export licenses and therefore fight malpractice e.g. smuggling.
- (xv) They may process the produce and thus increase its quality (value) while creating jobs.

Disadvantages of marketing boards:

- There is only one buyer, no competition, and therefore no efficiency.
- The boards are located in specific places, which cause locational imbalances as the board sells of its stock.
- Lack of managerial ability leads to mistakes in the boards operations.
- There is always mismanagement and embezzlement of funds.

- They are normally influenced by politicians.
- They run counter to IMF and World Bank policies of liberalization.

POPULATION ECONOMICS

Population is the number of people living in a particular area in given period of time.

Population structure and composition

This refers to the way the population of a country is distributed in terms of sex, age, occupational distribution, literacy rates, marriage etc.

Age distribution: there are three basic age group used in the description of population i.e. the young, old and the working class. This distribution is affected by fertility, birth rates, migration etc.

An age pyramid is used to illustrate the age distribution of a population.

This age pyramid is characterized by
Many young dependants
Few old dependants
Few young dependants

Where there is immigration.

This age pyramid is characterized
many old dependants
few people I the working class

This is attributed to movement of people the working age from other region in search of better economic prospects.

Population growth

This is a measure of the percentage increase in population. It is brought about by an increase in birth rate and a fall in death rate.

The theory of demographic transition.

The theory explains population growth from perspective. According to this theory, population in developed countries has gone through three stages;

Stage one: this was a stage of stationary development. The death rate was very high due to poor living conditions i.e. poor medical facilities, poor sanitation, poor diet and poor technology while the birth rate was also very high due to the low levels of education and a high demand for children because a large family was seen as a source of cheap labour in a subsistence peasant agricultural economy.

Stage two: this is the early expanding phase. The birth rate is still very high and the death rate is declining due to improved technology and better standards of living i.e. better housing and sanitation, improved medical care, improved control of epidemics, better diet and a more regular food supply. Therefore the rate of population growth is very high. Developing countries are still in this stage.

Stage three: this is the late expanding phase. The birth rate begins to fall due to improved standards of living followed by family planning and high education levels. There is also less emphasis on family labour due to changes in technology, a rising status of women, a greater emphasis on personal mobility that favours small families and greater urbanization, which weakens the traditional customs and beliefs and fosters modern attitudes towards family planning. Population growth is low. Developing countries have reached this stage.

Stage four: birth rate and death rates are at minimum and almost balance. The fertility rate falls below the zero point that is necessary for replacement. Total population decreases and it becomes an increasingly ageing population.

Malthusian population theory

Reverend Thomas Malthus was a British economist who lived in the 19th century. He noted with concern that the population of Britain was increasing more rapidly than ever before and he related this with the law of diminishing returns since the land was relatively fixed in supply. He believed that it would be impossible to increase food production to match the rate of production growth. According to him, man's biological capacity to produce exceeds his physical capacity to increase the supply of feedstuffs (means of subsistence).

Assumptions of the theory

- (i) Population growth depends on food supply. When food supply increases, the population also increases.
- (ii) Population grows at a geometric rate i.e. by simple doubling e.g. 1,2,4,8,16,32 etc while food supply grows at an arithmetic rate i.e. by a constant amount i.e. 2,4,6,8,10,12,14,16. etc. to him therefore, at one time, population growth would outstrip food supply resulting into famine, congestion, misery and death thus a population trap i.e. population growth would stop because of shortage of food.

Malthus identified two types of checks on population growth i.e. positive checks and negative checks.

Positive checks present a crude way of checking the population growth e.g. by famine, natural death and wars.

Negative checks reduce on birth rates e.g. late marriages, family planning etc.

ABC represents food supply growth

DBF represents population growth when there no positive checks

DBC represents population when there positive checks

Population cannot go towards B-F because beyond B people will start dying.

Malthus stood for the prevention of negative checks like family planning but instead argued that people should just have good morals to limit the number of children.

He also observed that any attempt to improved living conditions e.g. through giving subsidies by government would lead to further increase in population growth because the poor would produce more children hoping that some charitable people would look after them.

Criticism of the Malthusian theory

- (i) He assumed that resources like land are fixed and cannot increase in size but he ignored the fact that the resources can be improved e.g. by irrigation, drainage addition of fertilizers etc to produce a lot of food.
- (ii) He did not foresee the possibility of increasing food production through technology advancement but today there high yielding varieties of crops, tractors, combine harvesters, planters etc all of which have increased the efficiency of food production. Also, canning and preservation have enabled storage of food and its use for long periods of time. Improved transport facilities have enabled quick deliveries and have helped postpone the anticipated problem.
- (iii) That population pressure can be eased through migrations to areas with sparse population was not envisaged by Malthus.
- (iv) Malthus ignored the opening up of new areas and he concerned his theory with Britain, which he considered to be a closed economy. Many agricultural regions have been opened up in other places since then.
- (v) Malthus ignored the role of trade and foreign relations in the supply of food and other resources e.g. in the World Food Program Red Cross etc have helped to avert the dangers of starvation and death.
- (vi) Food is not the only determinant of population growth and there other factors e.g. migration, the level of education, culture, religion etc which Malthus ignored.
- (vii) He theorized that any rise in incomes above the subsistence level would lead to an increase in population. However, this is not always true and population growth rates can decline due to rise in the level of incomes and education, which improve the standards of living.
- (viii) The theory is based on land (agriculture) as the basis of the economy. However, developing countries have undergone transformation and so industry and commerce are systematically replacing the traditional agricultural sector.
- (ix) Malthus looked at population growth in purely negative terms. However, in some situations, population growth has been improved to be a positive component of the process development process.
- (x) Malthus never indicated the time when the population trap would be reached.

The relevance of the Malthusian theory to developing countries

- Population growth in some developing countries has checked by natural or positive checks e.g. famine, epidemics, etc as envisaged by Malthus.
- Malthus advocated family planning that is largely practiced.
- In LDCs where scientific and technological advances have not penetrated the traditional agricultural sector, the Malthusian theory is still relevant and productivity is declining as the population increases the Law of Diminishing returns is at work.
- The theory of optimum population is rooted in the relationship between food (resources) and the population.

Under population, optimum population and over population

Optimum population: this occurs when the available labour is just adequate to combine with the resources available to give maximum output without putting too much strain on the resources.

Under population: this occurs when the labour available is not adequate to combine with the available resources to give maximum output i.e. there are too few people to adequately utilize the resources available.

Over population: this occurs when there are too many people for the resources available. Over population may be shown by:

- Low per capita incomes and standards of living
- Low per capita output arising from the low ratio of productive assets per worker
- Shortage of land, capital and other resources. The pressure on the land leads to diminishing returns and environment degradation
- High level of employment and under employment
- Pressure on existing medical and other resources
- Shortage of housing facilities leading to overcrowding in the few houses

Causes of high population growth rates in developing countries

- (i) Cultural factors: children are seen as a source of wealth, prestige and insurance in old age.
- (ii) Medical care has been improved and so reduced death rates while the birth rates are also still high
- (iii) Polygamy: African families are polygamous in nature due to cultural and religious values. Such tendencies encourage high population growth rates.
- (iv) In an agrarian peasant economy, children, wives and dependants are seen as a source of cheap labour.
- (v) The high infant mortality rates in developing countries have made the poor to produce more children in an attempt to replace the dead ones and to ensure that they remain with some even if the deaths occur.
- (vi) High fertility rates of women in LDCs

- (vii) Early marriages due to inadequate education and employment opportunities.
- (viii) Low status of women, many of who are poor and illiterate. Such housewives believe that their key role is to produce children.
- (ix) Low level of urbanization: the traditional customs and beliefs are then still strong. A rural population has a lot of cheap food and accommodation and is not bothered by maintaining a big family. This encourages high birth rates.
- (x) Idleness in rural areas, and to some extent in the urban areas, makes the people view sex as a form of recreation.

Consequences of an increasing population

Positive consequences

- (i) Creation of wealth: large populations are better able to utilize the available resources of wealth.
- (ii) It increases the size of the market and makes it possible for the enterprises to enjoy the economies of scale.
- (iii) It increases the size of the labour force where there was under population and so makes the labour cheap lowering the unit cost of production.
- (iv) High population growth rates increase the population in an area and so justify the establishment of modern infrastructure in the area.
- (v) Efforts to hard work are stimulated and this promotes greater enterprise, innovation and invention to cope with the challenges. Historians agree that periods of rapid population growth were also period of extra ordinary intellectual fecundity e.g. it was when empire building occurred.
- (vi) High population growth and a big population enhance the importance and influence of a country in international affairs e.g. china is a supper power because of its population.

Negative consequences

- (i) Many social services will be run down due to strain.
- (ii) There is a heavy dependence burden especially where there was under population.
- (iii) This calls for more expenditure on education, housing, food, medical care, clothing etc. This reduces investment in more directly productive sectors e.g agriculture, industry, tourism etc.
- (iv) There are low saving rates because of excessive consumption. This leads to low investment, low capital accumulation and low incomes hence a vicious cycle of poverty.
- (v) The rate of illiteracy can increase due to inability of education facilities to cope with the increasing numbers. Illiteracy results into increased demand for children leading to further population growth.
- (vi) A big population size and high population growth rates increase the energy demands so increasing the demand for natural resources. This leads to pollution and degradation of the land, air and water resources, reducing the quality of life.

- (vii) The productivity of land decreases due to population pressure. This is especially so where modern technology has not penetrated the agriculture sector fast enough.
- (viii) There will be wide spread poverty because the resources are shared by too many people.
- (ix) There will be inflation because the too many people will produce too few goods and yet want to consume too much thence causing rises in prices of the commodities.
- (x) There will be low standards of living due to low per capita income.
- (xi) There is congestion, disease and famine, rural urban migration, high crime rates etc thence social strife. High population growth rates widen income disparities and cause social, political and economic discontent. Social tensions increase and land disputes multiply.

Population control

A population policy will aim at keeping the population at the optimum by checking population growth. It may also be aimed at increasing the capacity of the resources to satisfy the population. Population policy therefore includes:

- (i) Family planning: this includes the restriction of family size by using contraceptives and condoms. It is however not very easy to implement because of the fear of their side effects.
- (ii) Manipulating social and economic incentives and disincentives e.g. by reducing children's allowances and bursaries, imposing taxes on those who exceed a certain number of children and reducing maternity leaves.
- (iii) Education: this leads to postponement of marriage. Education of women also encourages them to concentrate on the quality of the children and not their quantity. Sex education in schools and through the mass media also helps to reduce the incidence of teenage pregnancies.
- (iv) Coercive policies: force is applied through various legislative measures. In extreme cases, sterilization or vasectomy and tubaligation can be forced onto the people e.g. in India.
- (v) Legalizing abortion to enable women produce at will and get rid of those fetuses that they do not want to produce.
- (vi) Encouraging international migrations from densely populated countries to those that are sparsely populated.
- (vii) Encouraging celibacy: this reduces the number of breeding humans and so helps to check population growth. It is however almost impossible to practice.
- (viii) Marriage age legislation: this aims to delay marriage and so delay the onset of reproduction.
- (ix) Urbanization: this weakens the traditional customs that are prevalent in rural areas that encourage high population growth. An urbanized population can

easily see the advantages of a small population in the housing, feeding, education etc.

Limitations to population control

- Religious opposition e.g. by Moslems and Catholics.
- Low levels of economic development that makes a large family advantageous as a source of family labour.
- Abortion is opposed by religious leaders and moralists as ungodly and a form of murder.
- Marriage age legislation is made difficult by the low education enrollment levels and the high drop out rates for the girls. This is coupled with the lack of birth related documentation, idleness and lack of income.

EDUCATION AS A FACTOR IN DEVELOPMENT

Education is the acquisition of knowledge and skills. It can be formal or informal. It offers a way by which to accumulate human capital.

Benefits of education

- It reduces the unemployment that is due to lack of skills and knowledge.
- It is a means to social change. It can be used to eradicate backward attitudes, practices, superstitions, beliefs, values etc and so create the right attitude, values and morals for economic progress.
- Education acts as a sieve and helps to identify competent and talented people for placement in areas where the best use can be made of them.
- Good education can be used as an instrument for rural development. Adult literacy campaigns, agriculture extension programmes, public health programmes etc can be easily disseminated through educating the rural population.
- It offers employment in the education sector e.g. to teachers. It also offers employment to those employed in industries that produce scholastic materials e.g. pens, books etc.
- It raises the quality of labour and its efficiency and productivity by increasing the technical knowledge of the labour.
- It improves the enterprenuerial skills of the people.
- It produces scientific personnel that undertake research and experimental projects. This leads to innovations and technological progress.
- It reduces income inequalities if it is accessible to all since almost all citizens will be educated and have chances of employment and getting a salary.
- It checks population growth since it delays marriage. Also, educated people tend to produce fewer children.

- Good education can be used to forge national unity, develop a sense of nationalism and to shape leadership qualities. All these are essential ingredients for accelerated economic growth.
- It increases demand for goods such as books, pens etc.
- It helps the nation to save forex that it would have otherwise spent on importing expatriate manpower.

Problems and negative roles of education in developing countries

- In LDCs there has been a deteriorating standard of education due to inadequate facilities.
- LDCs experience brain drain where the educated people leave their countries to work in other countries where they are highly paid. This wastes the money invested in their education by their native countries.
- Acquiring education involves high costs e.g. the cost of the buildings, teachers salaries and the opportunity cost e.g. the productivity foregone when the student is still at school.
- Educated people demand for imported luxurious goods that require a lot of foreign exchange.
- Many theoretical subjects are taught thus creating job seekers of white-collar jobs that are not readily available. This causes a problem of school leaver unemployment.
- There are many people who leave school without formal qualifications, skills and therefore employment. This causes wastage of human resources and causes frustration and misery.
- Failure to promote a sense of national unity: many educated elites instead examine national issues on narrow, myopic and sectarian lines with an alien predisposition.
- The present education system e.g. in Uganda is geared to passing examinations and obtaining certificates, diplomas and degrees. It has also tended to alienate the educated youths from the realities of their cultural and productive background.
- The education system does not prepare people to live in the rural areas. The educated elite despises manual labour and agriculture.
- The formal education sector has produced paper-qualified staff to replace the informally trained staff which is at times better at practical tasks.

Solutions to the problems of education

- Brain drain can be reduced by improving working conditions e.g. by increasing salaries.
- There should be serious man-power planning so that training is in line with the labour requirements to reduce the problems of unemployment.
- The education curriculum should be changed to suit the need of the developing countries. Vocational subjects like agriculture, woodwork, metal work and tailoring should be taught.

- Income inequalities between the educated and uneducated can be reduced by fiscal policy e.g. through progressive taxation.
- Rural development can help check rural-urban migration and encourages school leavers to go back to the rural areas.
- Educational loans and scholarships should be extended to the needy students. Work-study college programme should be encouraged to expose the youths to the world of work and enable students earn money for college costs.
- The government should provide enough facilities to the schools to improve the quality of labour trained.
- There should be free and compulsory primary education to reduce illiteracy rates and drop out ratios. This promotes equity and employment.
- Steps should be taken to ensure full utilization of the few available institutions and to increase opportunities for education through evening classes and distance education.
- Private investment in education especially in technical institutions, polytechnics and universities should be encouraged.
- National service schemes combining military training, manual labour and political education should be integrated into the education system to develop a sense of nationalism and establish a functional relationship between education and the world of work.
- Community oriented schemes e.g. adult literacy programmes, agriculture extension programmes should be encouraged to prepare the educated people to live in the rural areas.

Development and under development

Under development refers to low levels of utilization of resources. Under developed countries are also called developing countries.

Characteristics of developing countries

- Low levels of output per capita due to poor traditional methods of production.
- Production of primary products and a small industrial sector. Agriculture is predominant e.g. in Uganda.
- High levels of unemployment and under employment. Disguised unemployment is common especially in the agriculture sector.
- Low levels of urbanization: a large proportion of the population lives in rural areas.
- Low levels of consumption of electricity and other forms of energy.
- Low levels of specialization and division of labour.
- High population growth rates creating a large percentage of dependants.
- Basic human needs have not been adequately met e.g. body calorie needs, housing, clothing, safe drinking water etc.
- The physical quality of life i.e. average life expectancy, literacy rates etc are low while infant mortality rates are high.

- The human development index is low. This is based on three aspects of human living i.e. income per capita as an indicator of decent living, educational attainment and life expectancy.
- High levels of economic dependence.
- Inadequate capital: the rate of capita formation is low.
- Political instability: this is because the level of discontent is high. This has created a refugee problem.
- Low levels of technological progress.

Causes of underdevelopment

Internal causes

- **High population growth rates:** this has reduced the income per capita and standards of living. This reduces the level of savings and investment.
- **Many developing countries lack strategic raw material resources** like iron ore and oil, which dominated the core of industrialization and development in Western Europe.
- **Deficiency of entrepreneurial and managerial skills:** gross mismanagement and incompetence have wrecked the small enterprises that would have facilitated the social and economic emancipation of LDCs.
- **Political instability:** resources for development have been diverted to the purchase of military hardware. The insecurity in many developing countries has put productive areas to waste, curtailed resource inflow and led to capital flight and brain drain from developing countries.
- **Social cultural factors:** traditional attitudes, beliefs, cultures, value and practices are still deep rooted in the people's ways of life. This conservatism is an obstacle to social change since the people tend to resist new ideas.
- **Poorly developed social and economic infrastructure:** there are a few banks, power plants, insurance companies, roads and railways, stock markets etc to drive economic development.
- **Low levels of science and technology:** this has left many resources unexplored, unexploited and under utilized. In some situations, developing countries have adopted inappropriate technology, which strains them and makes them dependant on developed countries.
- **The vicious cycle of poverty:** low productivity leads to low incomes. The low incomes lead to low savings and the low savings lead to low investment. Low investment leads to low incomes and so the cycle continues.
- **Poor leadership:** most LDCs have or have had leaders who lack a sense of nationalism and an understanding of the politics of development.

External causes

- **Unfavourable trade position of LDCs:** most LDCs export primary products that fetch low prices and import manufactured goods which are more expensive causing deficits. The situation is made worse by the stagnation of world trade and the increased protection of markets by the developed countries.

- **Debt servicing:** this represents an outflow of the scarce foreign exchange. Debt servicing includes repayment of the principal and payment of the interest that accrues to the principal.
- **Brain drain:** developing countries lose their best manpower and are then forced to rely on expatriates who are expensive and put a strain on the countries scarce forex reserves.
- **Colonial and historical factors:** most developing countries were subjected to exploitation and oppression during colonial rule. Minerals and other resources were appropriated by the colonial masters. Colonial economic models were also made perpetually dependant on the colonial masters. Industry and technology were officially discouraged.
- **Neocolonialism:** developing countries, though officially independent, are still subjected to political manipulation and exploitation by the more developed countries. Developing countries have often been forced to adopt unfavourable policies that do not benefit them e.g. the Structural Adjustment Programmes (SAPs).
- Drain of income and repatriation of profits and other resources by the foreign owned business firms, multinational corporations consultancy firms etc to their mother countries denies the LDCs vital capital for development.

