AGRICULTURE.

FORM THREE NOTES .

BY :KARIUKI KEN KIRIMI.

Kirimiken2@gmail.com

TABLE OF CONTENTS.

CHAPTER ONE.

LIVESTOCK PRODUCTION III

(SELECTION AND BREEDING.)

Reproduction.

Process by which offspring are produced. Begin with fertilisation where after successful mating the female gamete(ovum) unites with the male gamete (sperm) to form a zygote.

In poultry eggs are fertilised internally but development of the chich takes place outside during incubation.

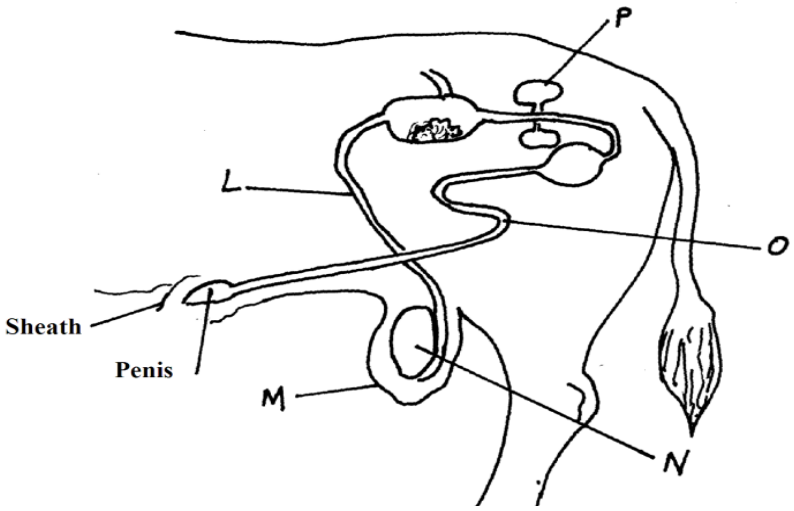
REPRODUCTION IN CATTLE.

Male reproductive organs produce male gametes, the spermatozoans.

The male reproductive system (bull)

Composed of :

- Testes
- Sperm ducts.
- Epididymis.
- Accessory glands(seminal vesicles and prostate gland)
- Penis.



1) **Testes.**

Enclosed by a loose skin (scrotum). The scrotum regulates the temperature of testes so that sperms do not die. Testes produce sperms which are stored in the epidymis.

2) **Sperm ducts.**

Epididymis proceeds to form the sperm ducts. Sperm duct carry sperms to the urethra which expels sperms and urine through the penis.

3) **Seminal vesicles.**

Produces a clear sticky fliud called semen.

4) **Prostate gland.**

Produces fluid that neutralises the acidic effects of urine in urethra hence preventing death of sperms.semen carries sperms out of the penis.

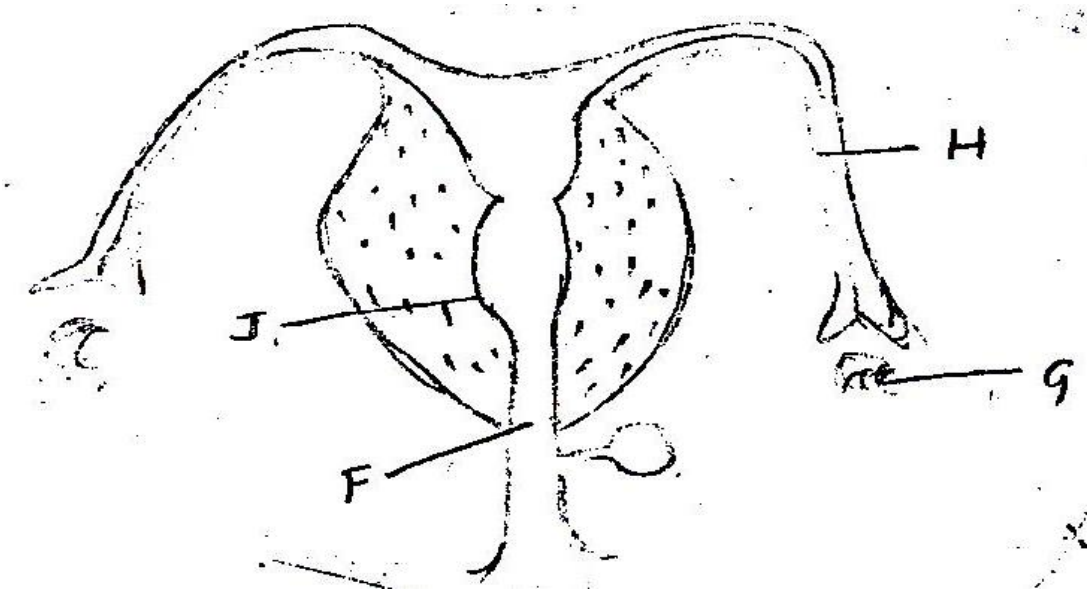
5) **Penis.**

Introduces sperms into the vaginaof the cow through the vulva during mating.

FEMALE REPRODUCTIVE SYSTEM.

Composed of the following:

- Ovaries.
- Fallopian tubes(oviducts)
- Uterus.
- Vagina and vulva.



Ovaries and the fallopian tubes (oviducts)

Produces the female gametes (ova)

Produces oestrogen under the influence of follicle stimulating hormone. (FSH)

Oestrogen is produced by the graafian follicle and it induces oestrus.

Ovulation. Release and movement of the ovum down the uterus.

Vagina and the vulva.

Vulva. External opening of the cows' reproductive system. Allows mating to take place so that the sperms are deposited into the vagina.

PREGNANCY/GESTATION PERIOD.

It is the period between fertilisation of the ova and the expulsion of the foetus.

Animal.	**Length in days.**
Cow.	270-285
Sow.	113-117
Ewe and goat	150
Rabbit	28-32

Progesterone produced by placenta maintains pregnancy.

Parturition.

Act of giving birth in female animals.

Signs of parturition.

- Distended udder that produces thick milky fluid. (Colostrum)
- Swollen vulva producing a thick mucus-like discharge.
- Loose and slackened pelvic girdle.
- Visible pin bone.
- General restlessness.

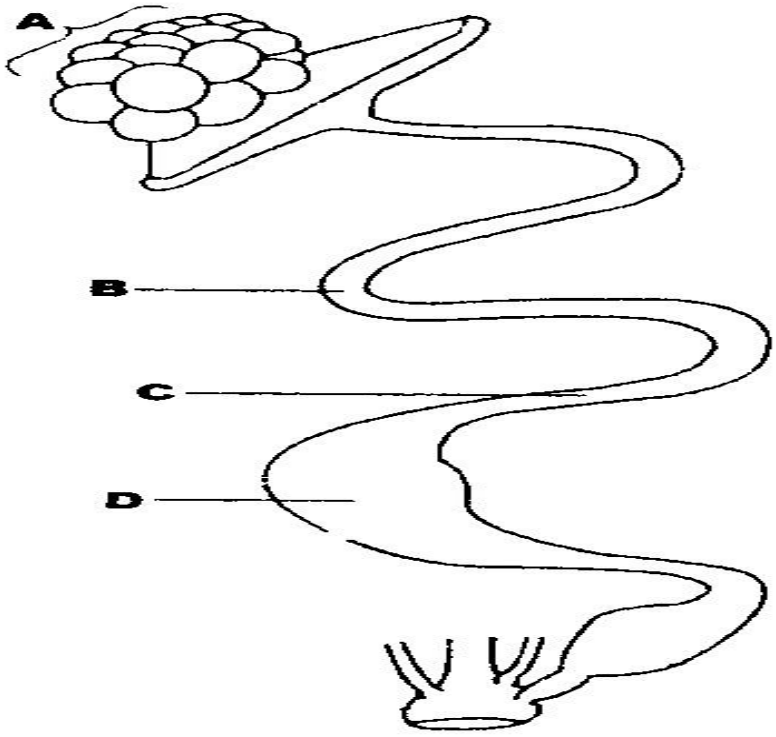
Mal-presentation/breech presentation.

Occurs when the front legs and head do not come out first during parturition.

REPRODUCTION IN POULTRY.

The cock has testes within its body.

The hen has an elongated oviduct necessary for formation of an egg. Fertilisation is internal.



Reproductive system of a hen.

- Ovary.
- Funnel/infundibulum.
- Magnum.
- Isthmus.
- Uterus.
- Vagina.
- Cloaca.

1) **The ovary.**

The hen has two ovaries but only the left one is functional.

Ova (eggs) are formed in the ovary.

Ovum is held firmly by a protective device (follicle) which burst when the yolk is mature.

2) **The funnel/infundibulum.**

Fertilisation takes place in the funnel and chalazae added to the yolk. The egg stays here for 15 minutes.

3) **Magnum.**

Thick albumen are added. Stays for 3 hours and is 33cm long.

4) **Isthmus.**

It is 10.6 cm long and the egg stays here for 15 min.

Shell membrane is added. This determines the shape of the egg.

Water, mineral salts and vitamin are also added.

5) **Uterus (shell gland)**

Has calcium deposits. Shell is added here plus addition of albumen is completed.

The egg stays here for 18-22 hours.

6) **Vagina.**

It is 6.9cm long.

Temporal storage of egg before it is laid.

7) **Cloaca.**

Egg moves out of the cloaca through the vent.

The cloaca extend out to prevent egg from breaking.

- Sometimes the cloaca may fail to retract after extending to allow for egg laying. This condition is called cloaca prolapse and it may cause cannibalism.

N/B

Egg laying is not dependent with fertilisation.

The components of an egg are obtained from the body reserve of a hen.

SELECTION.

Process of allowing certain animals to be parents of future generation while culling others.

Animals culled have undesirable characteristics.

Selected males and females makes up the breeding stock.

Selection increases occurrence of the desirable genes and reduces occurrence of undesirable genes.

Heritability.

Likelihood of a particular trait being transmitted to the offspring.

Degree to which selection affects a character depends on the following:

- Heritability of the character.
- Intensity with which selection is done.
- The interval between generations and the kind of selection being practised.

FACTORS TO CONSIDER WHEN SELECTING A BREEDING STOCK.

1) **Age.**

Young animals have a longer productive life. Old animals are low producers and poor breeders. Production declines with age.

2) **Level of production.**

Select animals with the highest production.

Good performance is indicted by high milk. Wool and egg production, high growth rate and good mothering ability.

High prepotency. Ability of the parents to pass good qualities to the offspring.

3) **Physical fitness**.

Animals selected should be free from any physical defects e.g. mono-eyed, limping, irregular number of teats, scrotal hernia or defective and weak backline.

4) **Health.**

Select healthy animals. Sick animals do not breed well and are expensive to keep.

5) **Body conformation.**

Should have proper body conformation. E.g. wedge-shaped, large udder, thin legs, long neck for dairy cows.

6) **Temperament or behaviour.**

Animals with a bad temperament or undesirable behaviour e.g. cannibalism and gg eating, aggressiveness should be culled.

7) **Quality of products.**

Select animals that give products of high quality.

8) **Mothering ability.**

Select animals with a good mothering ability. (Animals with good natural instinct towards their young ones)

9) **Adaptability.**

Select animals well adapted to the prevailing climatic conditions in the area.

10) **Prolificacy.**

Select highly prolific animals. (Ability to give birth to many offspring at a time)

METHODS OF SELECTION.

1) **Mass selection.**

Consist of choosing animals for breeding on the basis of their own performance and then mating them randomly.

Offspring will show higher performance than the previous herd.

2) **Progeny testing.**

Progeny. Offspring resulting from selected parents.

It is used when the character to be selected is of low heritability.

3) **Contemporary comparison.**

Involves comparison of the average production of the daughters of each bull with that of the other heifer.

It assumes that differences between the herds of the same breed are non-genetic in origin.

Advantages of contemporary comparison.

- It is possible to compare animals of different age groups since heifer location is used.
- Eliminates differences brought about by environment since average performance of the herd is used.
- Accurate. Can only be used accurately in large herds of animals.
- Possible to make direct comparison of bulls of different artificial insemination centres.

BREEDING.

Process of mating selected males and females to produce offspring of the required characteristics.

Reasons for breeding.

- To expand inherited potential of the animal.
- To overcome production problems created by the environment.
- To satisfy the consumers' taste.
- For economic reasons.

INHERITANCE.

Genetic transmission of characteristics from parents to offspring.

An animal body is made up of two types of cells.

Sex cells (gametes) and somatic cells (body cells)

Inheritance is carried by the gametes controlled by genes found in chromosomes.

Chromosomes.

Carry genes which determine the specific characteristics in an individual animal. Exist in pairs in the nucleus of body cells and are always constant in number.

Genes.

Tiny units of inheritance carrying particular qualities found in animals. The specific point of location of a gene on a chromosome is called gene locus or loci. Alleles are genes found on corresponding loci of a pair of chromosome. If the allelomorphic genes have the same effect, the character is known as homozygous. If allelomorphic genes have a different effect that carry different qualities the resulting character will be heterozygous.

Cell division.

The somatic/body cells divide and reproduce by a process called mitosis. Each parent produces two daughter cells. The new cells formed have the same number of chromosome pairs as the parent cell.

Sex cell/gametes divide and reproduce through a process called meiosis. It is reduction division since the number of chromosome in the sperm and those in the ova are reduced to half the normal number in the resulting daughter cell. During fertilisation, ovum and sperm joins and the full number of chromosome pairs is restored.

TERMS USED IN BREEDING.

1. **Dominant and Recessive characteristics.**

Dominant gene is one that suppresses the other and produces a dominant characteristic.

Recessive gene is one that is suppressed by the other and produces a recessive characteristic.

2. **Hybrid and hybrid vigour.**

Hybrid is an animal which is a product of crossing animals of two different breeds.

Hybrid vigour/heterosis.

Increased performance resulting from crossing two unrelated superior breeds.

Genes that produce vigour are dominant while those lacking are recessive.

3. **Epistasis.**

This is the masking of the effect of one gene by another gene which is non-allelic situated on different t locus.

Breeding systems.

Inbreeding.

Outbreeding.

Inbreeding.

Mating of animals that are closely related.

Reasons for inbreeding.

- To increase genetic uniformity in the herd through increasing homozygosity.
- Used to fix required characteristics in the new breeds as a final stage in development of a new breed with permanent characteristics.
- To increase phenotypic uniformity.
- Used to get proven sires. Male animals that have been confirmed and proven to have very high qualities through backcrossing.

Backcrossing. Mating sires with their daughters.

- Sure method of testing whether an animal has high ability of passing its desirable characteristics to the offspring.

Disadvantages of inbreeding.

- Can lead to loss of hybrid vigour.
- May lead to decline in fertility leading to species extinction.
- Brings about reduction in performance.
- Leads to high rate of pre-natal mortality.

Systems of inbreeding.

1) **Close breeding.**

Breeding of very closely related animals. Could be sib-mating (brother and sister) or parent-sib mating (sons and mother, daughter and father)

2) **Line breeding.**

Mating distantly related animals that share a common ancestor. Used to preserve good qualities of superior ancestor.

Outbreeding.

Mating between animals which are not related.

Reasons for outbreeding.

- To introduce new genes in an existing herd.
- To exploit heterosis.
- To establish a new breed or a grade animal.

Systems of outbreeding.

- Outcrossing
- Cross breeding.
- Upgrading (grading up)

1) **Outcrossing.**

Mating unrelated animals within the same breed.

It maintains characteristics of pure breeds. It also improves low producing animals within the same breed.

2) **Crossbreeding.**

Mating two animals from different breeds.

Cross bred animals have heterosis.

3) **Upgrading. (Grading up)**

Crossing where the female of low grade stock is mated with a pure bred sire. Used in improving local cattle for milk production.

MATING IN LIVESTOCK.

Oestrus (heat period)

Duration from one heat period to the other is called the oestrus cycle.

Signs of heat.

- Restlessness.
- Mounting others and when mounted on, it stands still.
- Slight rise in body temperatures.
- In lactating cows, milk yields drops slightly.
- Vulva swells and becomes reddish.
- Clear or slimy mucus from the vagina.
- Bellowing or mooing frequently.

Mating in pigs.

Signs of heat.

- Restlessness.
- Frequent urination.
- Swelling and reddening of the vulva.
- Clear or slimy mucus discharge from the vulva.
- Frequent mounting others.
- Responds positively to the riding test.

Mating in rabbits.

6-7 months does are ready for mating.

Oestrus cycle is 14 days.

Signs of heat.

- Restlessness.
- Frequent urination.
- Swollen vulva.
- Doe throws itself on its sides.
- Doe rubs herself against the wall or any other solid object.
- The doe tries to contact other rabbits in the next hutch by peeping through the cage walls.

METHODS OF SERVICE IN LIVESTOCK.

- Natural mating.
- Artificial insemination.
- Embryo transfer.

Natural mating.

Use of male to serve a female.

Advantages of natural mating.

- More accurate as male can detect when the female is on heat thus increases chances of conception.
- Less laborious as there is is no need of checking the animal for heat signs.
- Useful when heat signs of females cannot be easily detected.

Disadvantages of natural mating.

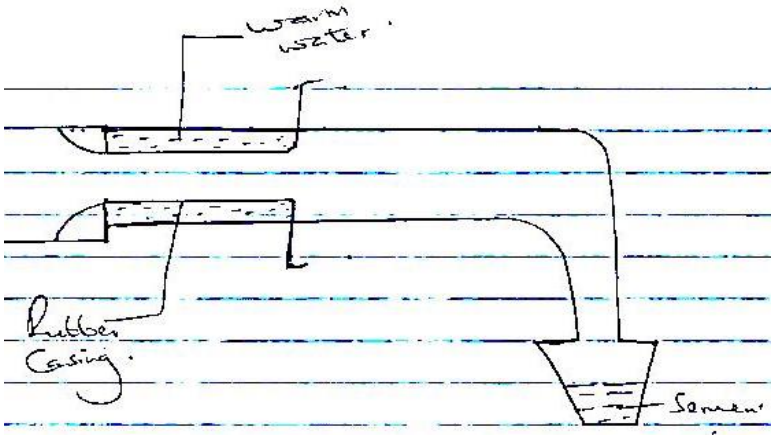
- Inbreeding is not easily controlled.
- Possible to transmit breeding diseases such as brucellosis or parasites such as Trichomonas spp.
- Males will need extra pastures to eat.
- Large males can injure small females.
- Wastage of semen as a single ejaculation produce semen that can serve several cows.
- Cumbersome and expensive to transport bull to hot areas to serve cows.

Artificial insemination.

Introduction of semen into the female reproductive tract by hand using syringes/tubes.

Procedure of collecting semen.

Restrain the cow (teaser) in a crush. A bull is then brought to the teaser cow and when it mounts the cow and directs the penis to the vulva, a person grabs the penis immediately and directs it to the artificial vagina where the bull ejaculate and semen is collected.



An artificial vagina.

Advantages of artificial insemination.

- Semen from one superior bull can be used to serve many cows. About 3,400 cows while for natural mating only 30-50 cows can be mated per season.
- Sires that are unable to serve cows due to heavy weight or injury can produce semen to serve cows.
- Prevents large bulls from injuring small cows.
- Reduces expenses of keeping a bull on pasture and veterinary bills.
- Semen can be stored for a long time even after the death of a bull.
- Easy to control breeding that is it is possible to time when to breed.
- Eliminates dangerous bulls from the farm.
- Useful research tool. Possible to study a very large number of daughters from a single sire.

Disadvantages of AI.

- Harmful characteristics can be spread quickly by one bull to the offspring.
- Requires skilled labour.
- Low chances of conception as semen may die due to storage and transport problems and wrong timing of heat period.
- More labour demanding in checking for heat signs.

Embryo transplant.

Ova (eggs) are harvested from a high quality cow (donor) fertilised in test tubes and embryos implanted into foster mothers (recipient)

The donor is injected with hormones to enable multiple ova production.

Advantages of Embryo transplant.

- Stimulates milk production in a female cow that was not ready to produce milk.
- A highly productive female can spread over a large area to benefit many farmers.
- Easier to transport embryos in test-tubes than the whole animal.
- Embryos can be stored for long periods awaiting availability of a recipient female.

Disadvantages of Embryo transplant.

- Expensive.
- Requires trained personnel to handle administer.
- Requires special equipment for fertilisation and storage of embryos.

Signs of parturition.

Signs of parturition in cattle. (Calving down.)

- Restlessness.
- Enlarged or swollen vulva.
- Clear mucus discharge from the vulva.
- Slackening of pelvic muscles/relaxing of hip muscles.
- Full and distended udder.
- Thick milky fluid from the teats.
- A water bag appears and burst just before calving.

Signs of parturition in sow.

- Restlessness.
- Vulva turns red and swells.
- Udder becomes full with a milky fluid.
- Sow starts to build a nest by collecting some bedding at one corner of the pen.

Signs of parturition in rabbits.

- Goes off feed.
- Start building nest by plucking off hair from her belly.

CHAPTER TWO.

LIVESTOCK PRODUCTION IV.

(LIVESTOCK REARING PRACTICES.)

ROUTINE LIVESTOCK REARING PRACTICES.

Routine. Is a fixed way of doing something.

Feeding.

There are certain periods when specialised feeding is required.

a) Flushing.

Involves giving highly nutritious feed around service time.in sheep 2-3 weeks prior to tupping and 3 weeks after. In pigs, 3-4 weeks before service.

Importance of flushing.

- Increases conception rate. This is due to higher ovulation rate.
- Facilitates implantation of the zygote.
- Increases lambing percentage (15-20%) in Ewes and chances of multiple birth.

b) Steaming up.

Providing extra feed of high nutritive value to an animal during the last weeks of gestation. This is when rapid foetal development takes place.

Animal.	**Time to steam-up.**
Cow.	6-8 weeks before calving.
Ewe.	3-4 weeks before lambing.
Dairy goat (Nanny)	3-4 weeks before kidding.
Doe (rabbit)	2 weeks before kindling.
Sow.	6 weeks before farrowing.

Importance of steaming-up.

- Reduces incidences of pregnancy toxaemia (twin lamb disease). This is where a Ewe carrying twins loses most of the nutrient in body reserve.
- Provides nutrients for maximum foetal growth.
- Helps build up energy for parturition.
- Ensure birth of a healthy animal.
- Promotes good health of the mother.
- Increases and maintains high milk yields after birth.

c) Creep feeding.

Feeding of young animals from birth to weaning.

Piglets.

Weaned at 8 weeks.

Creep pellets are given at 10 days and contains 16-18% DCP.

At 6 weeks creep pellets are mixed gradually with sow and weaner.

Lambs.

They should suckle colostrum 1-2 hours after birth.

Qualities of colostrum.

- It is highly digestible.
- Contains antibodies inform of gamma-immunoglobulin which are absorbed through the GIT directly.
- It is highly nutritious. Contains vitamin A, B and E. carotene is responsible for yellow colour of the colostrum.

At 6 weeks lambs are given succulent soft herbage and small amounts of concentrate.

They are weaned at 4-5 months.

PARASITE AND DISEASE CONTROL.

Vaccination.

Active immunisation.

It is the process of introducing active disease organism reduced in strength or virulent into an animal's body.

Routes of vaccination.

- By injections.
- Orally through the mouth.
- By inhalation through the nose.
- Through the cloaca.
- Ocular through the eyes.

GROUPS OF VACCINES.

1. **Live virulent vaccines.**

Living organisms capable of causing diseases to man animal. They cause the diseases thus stimulating production of antibodies against it.

It is not commonly used.

Virulent means highly infectious.

2. **Live attenuated vaccines.**

Diseases causing organisms whose ability to cause the disease has been reduced.

Used in anthrax, brucellosis, rinderpest, foot and mouth.

If stored for long, they mutate to virulent forms.

Stimulate production of high level of antibodies.

3. **Killed or dead vaccines.**

Diseases organisms that are completely killed by use of phenol or formaldehyde.

4. **Toxoids.**

Are made from toxins produced by disease causing microorganisms and then treated with formalin to produce toxoid vaccines.

Properties of a Good vaccine.

- Immunity it produces should be as good as natural immunity.
- Should have a long keeping life.
- Should be easy to administer to the animal.
- Should have no side effects when inoculated.
- Should be compatible with other vaccines given to the animal.
- A single dose should produce lifelong immunity.

Care in handling vaccines.

- Keep under freezing temperatures -20 to -4 degree Celsius.
- Vaccination equipments should be sterilised.
- Correct dosage should be adhered to.
- Use the correct route of administration.

Deworming.

Regular deworming with anthelmintics administered orally through the mouth using a dosing gun, bolus gun or narrow necked bottle.

Hoof trimming.

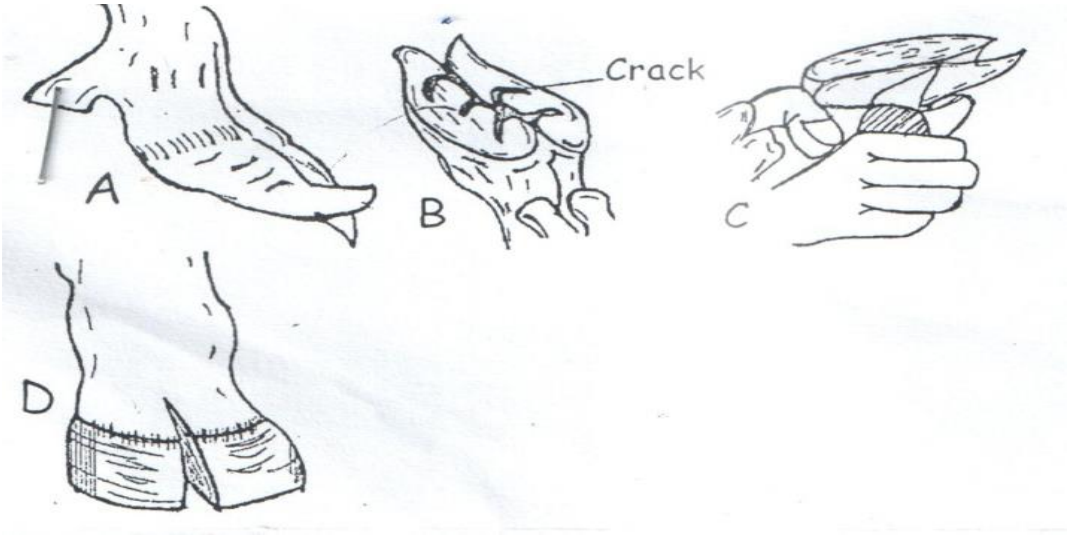
Cutting back of overgrown hooves.

Overgrown hooves are common in sheep that are on soft pastures.

Overgrown hooves encourage accumulation of dung in the folds that leads to cracking, bleeding of hooves and rooting of skin.

Tools used are:

Hoof trimming knife, hoof cutter or hoof rasp.



A. Showing overgrown hoof.

B. showing cracks in the overgrown hoof.

C. hoof trimming in progress.

D. a trimmed hoof.

Reasons for hoof trimming.

- Facilitates easy movement.
- Controls foot rot disease
- Prevents ram from injuring the ewe during tupping.

Docking/tailing.

Removal of tail or dock.

Reasons for docking.

- ❖ To facilitate tupping or mating.
- ❖ To give a good fat distribution throughout the body.
- ❖ Prevent blowfly infestation.

Methods of Docking.

1. **Elastrator and rubber ring.**

The ring is applied before lambs are 48 hours old.

Leave about one inch of the tail to cover the vulva in female.

2. **Burdizzo and knife.**

The tail is crushed between vertebrae joints then the tail is cut off. Crushing stops bleeding.

Apply antiseptic to prevent infection. Done when lambs are 2-3 weeks.

3. **Knife.**

Cut between the vertebrae joint and mild antiseptic applied. Done when lambs are 7-10 days old.

4. **Hot iron.**

There is no bleeding and it has little risk of infection.

Dipping and spraying.

Routine practice done to control external parasites.

Plunge dips are used for large stock while Machakos dip is used for sheep and goats.

Shearing is done in sheep before spraying so that chemicals can penetrate up to the skin.

Dusting.

Chemical powder applied to control external parasites using a duster.

Houses should also be dusted ensuring all cracks and crevices are filled with powder.

BREEDING PRACTICES.

1. **Crutching and Ringing.**

Crutching. Practice of cutting wool around the external reproductive organs of a female sheep to facilitate mating and prevent infection.

Ringing. Practice of trimming wool around the sheath of the penis of rams to facilitate mating.

2. **Tupping and Serving.**

Tupping. Act of mating in sheep and goats.

Serving. Mating in cattle and pigs.

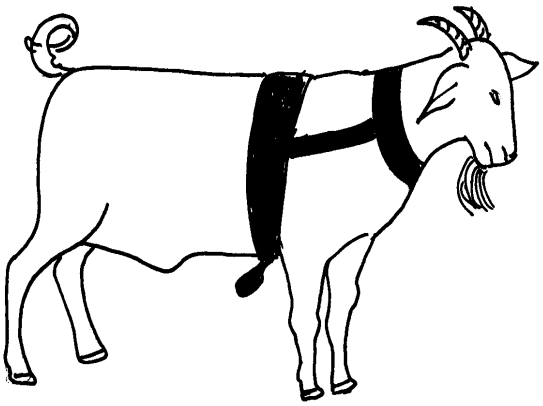
3. **Raddling.**

Practice of fitting rams with breeding chutes painted in different colours during mating.

Fitted on underside around breast of ram.

It helps to identify Ewe that have been mated by a particular ram.

Colour should be changed after 10 days to detect Ewes with repeated heat or infertile (both males and females.)



Identification.

Importance.

Helps in

- Selection and breeding.
- Diseases control and treatment.
- Feeding.
- Record keeping.
- Culling.

Methods of identification.

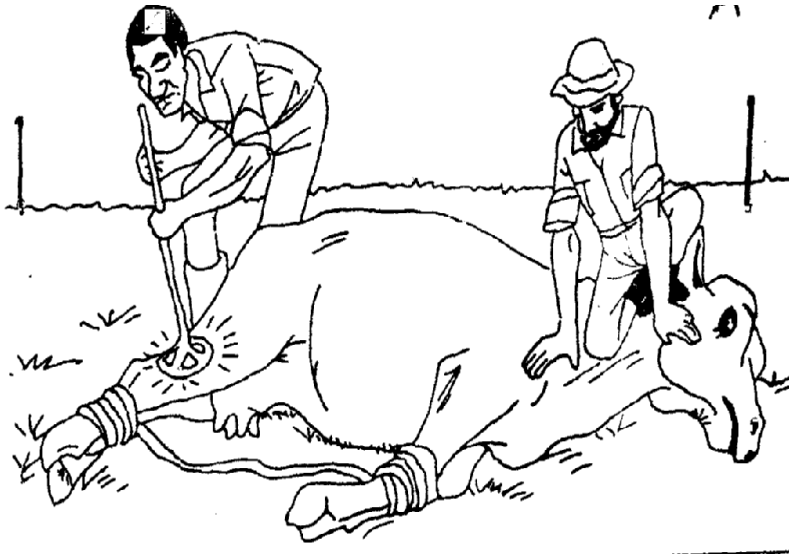
Branding.

Marking of animals on skin using permanent marks. E.g. use of hot iron with identification marks inscribed on it.

Disadvantages.

- Causes a lot of pain to the animal.
- Reduces quality of hides and skin if poorly done.

Branding spots. Below hock, side of animals jaw.

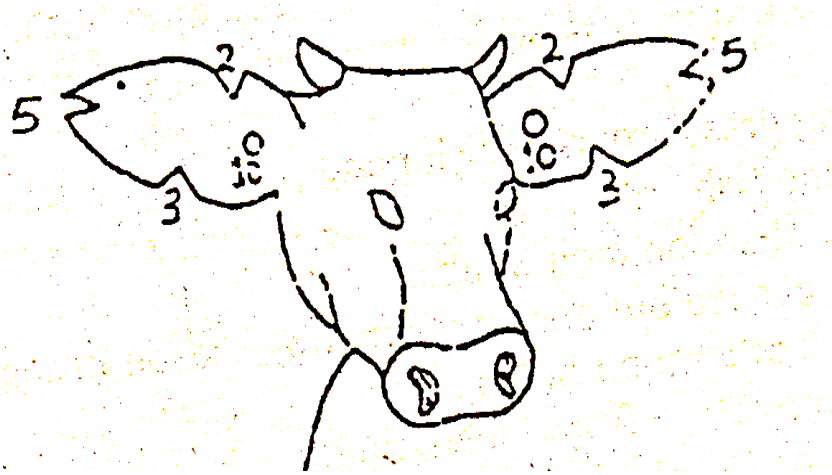


Ear tagging.

Plastic or metal tags bearing numbers or letters are fixed through a hole perforated on the ear. Tags are convenient as they are flexible and can twist out easily when held by twig.

Ear Notching.

The ears of the animal is perforated to make different shapes. (Notches)



Tattooing.

These are shapes, numbers or letters made on the skin with a permanent ink or dye.

Made using tattooing machine.

Suitable for pigs and rabbits.

Light coloured parts of the animals body are tattooed e.g. muzzle, udder and ear.

Neck strap or chain.

Easy and does not injure the animals skin but plates can get lost easily when animals are grazing.

Debeaking.

Done to control vices such as cannibalism and egg eating.

1/3 of upper beak is cut. (Knife or scissors are used.)

Hot iron cauterises the wound.

Tooth clipping.

Removal of canine teeth in piglets 24 hours after farrowing. Uses a tooth clipper.

Reasons for tooth clipping.

- Prevent the piglet from injuring the sow during suckling.
- Prevent the piglets from inflicting injuries to other piglets.
- Prevent injuries to the farmer during handling of piglets.

Culling.

Removal of unproductive animals from a breeding herd so as to leave high quality and productive animals.

Male animals are culled by castrating and fattening for sale.

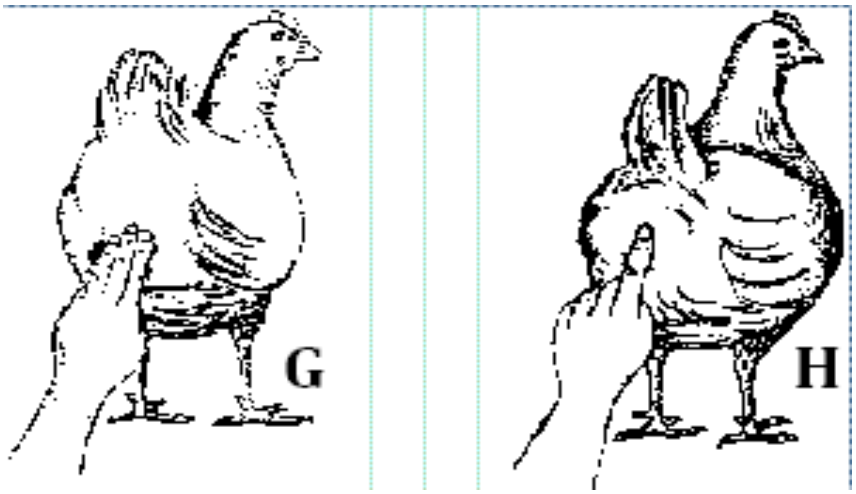
Basis for culling.

- Poor health.
- Poor production.
- Old age.
- Presence of physical deformities.
- Infertility.
- Poor mothering ability.
- To avoid inbreeding.

CULLING IN POULTRY.

Poor layers.

- Skin colour changes from white to yellow pigment in vent, legs and beaks.
- Combs, wattles and vent become shrivelled.
- Width between pelvic bone becomes narrow. (Good layers 2-3 fingers can fit between the pelvic bones, non-layers only one finger.)



Good layer. **Bad layer.**

- Eyes become dull.
- Breast become hard.

Dehorning.

Reasons for dehorning.

- To prevent cattle from inflicting injuries on each other.
- Make animals docile and easy to handle.
- For easy transportation and feeding as polled animals occupy a small space.
- Prevent destruction of farm structures.

Methods of Dehorning.

Dehorning. Removal of horns.

Disbudding. Removal of horn buds (before becoming hard cartilages)

1. **Use of caustic potash stick (potassium hydroxide)**

Used for disbudding.

Procedure.

- Restrain the animal.
- Clip hair around the horn bud.
- Rub the bud with caustic potash paste.
- Restrain the animal for about 30 minutes to prevent paste from getting into eyes or rubbing off.
- Release the animal.

2. **Use of disbudding iron.**

Involves use of hot iron.

3. **Use of dehorning saw or wire.**

After dehorning, a fly repellent should be used to repel off flies from the wound.

4. **Use of rubber ring and elastrator.**

Applied on the base of the horn when horns are young and have soft tissues.

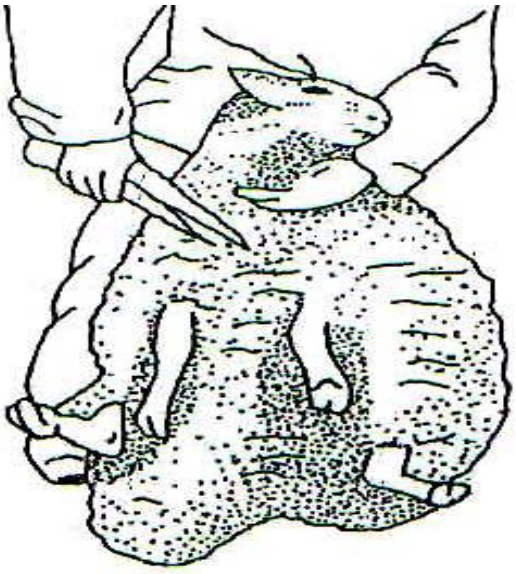
5. **Use of dehorning collodion.**

Chemical method. Collodion is applied onto the horn bud and it eats away the horn.

Shearing.

Cutting wool from wool sheep breed. Done at 8 months of age and thereafter once a year.

Care should be taken not to cut the skin, testicles, udder, vulva or penis.



Castration,

Rendering unserviceable the testicles of male animals thus depriving its reproductive power.

This inhibits secondary sexual characteristic, growth and functions.

Reasons for castration.

- To control breeding diseases such as brucellosis, vaginitis, and trichomoniasis transmitted through natural mating.
- To control breeding.
- For faster growth rates.
- Increases quality of meat by removing unpleasant smell in goats.

Methods of castration.

Birds. Caponisation.

Open method.

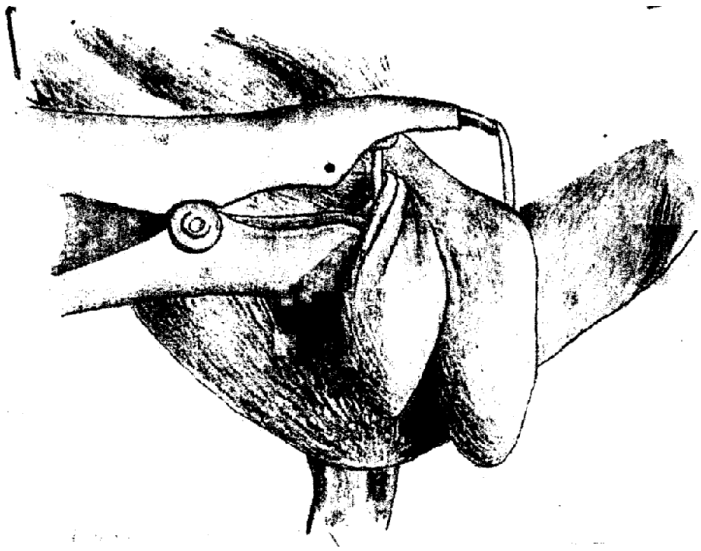
Closed method/ bloodless method.

1) **Closed castration methods.**

There is no cutting of the skin and bleeding does not occur. Includes.

a) **Use of elastrator and rubber ring.**

Applied above the scrotum and the spermatic cords and blocks the spermatic cords.



b) **Use of a Burdizzo.**

The jaw of the Burdizzo is placed on the spermatic cords of one testicle and crushed and this is repeated on the second testicle and this operation is repeated on two sections to avoid re-joining of spermatic cords.

2) **Open castration method.**

Surgical method used for castrating cocks, piglets and rabbits that have reproductive organs internally. Artery –off forceps are used to close up open blood vessels to stop excessive bleeding.

3) **Caponisation.**

Act of making male birds lose their male characteristics.

Uses a hormone stilbestorl injected into birds at one day old. **Capons** are male birds that have been castrated.

Can also be done by implanting pellets of female sex hormone underneath skin of the neck of the bird. Can be done surgically through open method.

MANAGEMENT DURING PARTURITION.

Parturition. The act of giving birth in females.

Animal.	**Parturition term used.**
Cattle.	Calving/calving down.
Pigs.	Farrowing/farrowing down.
Sheep.	Lambing/lambing down.
Goats.	Kidding/kidding down.
Rabbits.	Kindling/kindling down.

Parturition in sheep (lambing.)

Gestation period is 150 days.

Lambing management.

1. **Drift lambing.**

All pregnant Ewes are put together in one paddock and then separated as they lamb-down.

They are removed on a daily basis.

2. **Pen lambing.**

Ewes separated from others after showing signs of lambing and put on their own individual pen to lamb down.

Signs of lambing.

- Udder becomes full and teats bright red in colour.
- Restlessness and bleating.
- Slackening of hip muscles.
- Water bag appears and burst signalling the start of lambing.

The mother is allowed to lick the lamb to ensure coat is dry to avoid death due to cold.

Parturition in Goats. (Kidding)

Nannies carrying twins kid a few days earlier.

Signs of kidding.

- Udder become firm and teats enlarge.
- Muscles at either side of tail slacken.
- Restlessness is shown by pawing the ground, rising up and lying down frequently.
- Separating itself from the rest of the herd.

- A clear discharge from the vulva.

The nanny should be kept with another female to avoid nervousness.

Parturition in cattle. (Calving)

Calving management.

- Separate the cow from the rest when it start showing signs of calving.
- Put the cow in a clean disinfected individual pen.
- Keep constant watch for any complications during calving but do not disturb the cow.
- In case of mal-presentation/breech birth seek help of a qualified stockman/veterinary doctor.
- Ensure the calf is breathing/wipe mucus on the mouth and nose of the calf.
- Let the mother lick the calf dry to avoid death due to chilliness.
- Ensure the calf suck colostrum during the first 2 hours of life.
- Ensure the afterbirth is removed and dispose it.
- In case the after birth is retained for more than 72 hours seek help from a veterinary doctor.
- Transfer the calf to a clean, dry and warm pen.

Parturition in pigs. (Farrowing)

Clean and disinfect the farrowing pens.

Clean the sow skin with water and soap to remove all external parasites.

The sow is put in the farrowing pen 3 days to farrowing in order to:

- Familiarise with the new environment to reduce nervousness.
- Avoid inconveniences of transferring piglets in case of early parturition.

Signs of farrowing.

- Sow becomes restless.
- Enlargement of vulva.
- Muscles on each side of tail slacken.
- Loss of appetite.
- Udder and teat become enlarged.
- Sow collects bedding material at one corner to build a nest.
- Milk is present in teats 24 hours before farrowing.

Attendant should be present to ensure the following:

3. Piglets are breathing.
4. Piglets are warm.
5. Piglet suck colostrum.
6. To cut and disinfect naval cord to avoid naval illness.

7. Ensure removal of after birth to prevent the sow from eating it and sows which eat afterbirth are known to eat even their piglet. It also prevent it from decomposing in the house and becoming source of infection.

Parturition in rabbits. (Kindling)

Gestation period is 28-32 days.

Provide a nest box with dry soft bedding.

Signs of kindling.

The doe plucks off fur from her body.

Uses the fur to build a nest.

BEE KEEPING. (APICULTURE)

Importance of keeping Bees.

1. Production of honey which is:
   - A high energy feed.
   - Sweetener for beverage and soft drinks.
   - Medicinal- used to dress fresh wounds.
2. Honey and bee wax are sold to earn income.
3. Bees are good pollinators for many crops.

Types of Bees.

1. African wild Bee (Apis *mellifera adansonii*)
2. European Bee.

Characteristics of African wild Bee.

- Well adapted to local weather conditions e.g. high temperatures.
- Has high flying power thus can fly for long distances.
- More active in search of food and water and protecting the hive.
- Vicious if manhandled.
- Fairy resistant to diseases e.g. acarive and American foul brood disease.

Characteristics of European Bee.

- More gentle and larger than African bee.
- Less active and vicious than African bee.
- Susceptible to disease that attack bees.

BEE COLONY.

Types of Bees.

1) **The queen.**

There is only one queen in the colony.

It is the largest bee in the colony.

Functions of the queen.

1. Lays fertilised eggs. Mating takes place in the air requiring 5-7 drones. The queen stores sperms in a **spermatheca** hence requires mating only once in its lifespan.
2. Keeping the colony together by producing a pheromone called **queen substance of identification.**

2) **The Drones.**

They are 300 in number.

Functions of the Drones.

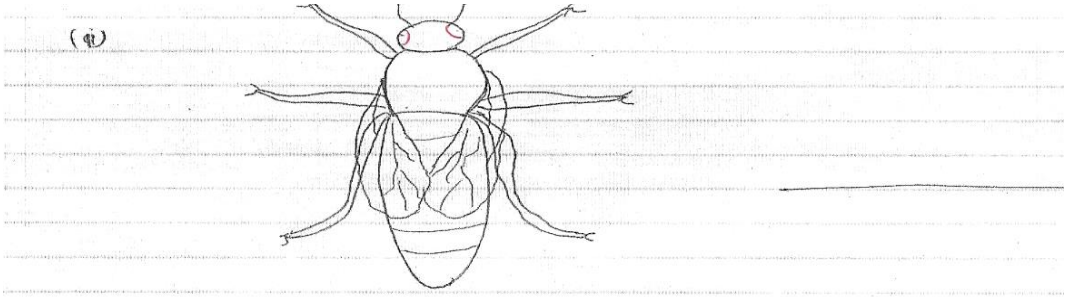
1. To fertilise the queen. Those that take place in this nuptial flight are killed after this by the worker bees.
2. Control temperature /cool the hive by flapping their wide wings at high speed.

3) **Worker Bees.**

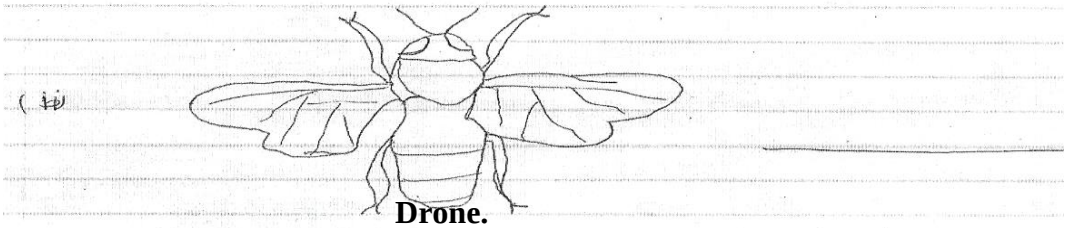
They are 60,000 in number. They are the smallest and are female bees.

Functions of the worker Bees.

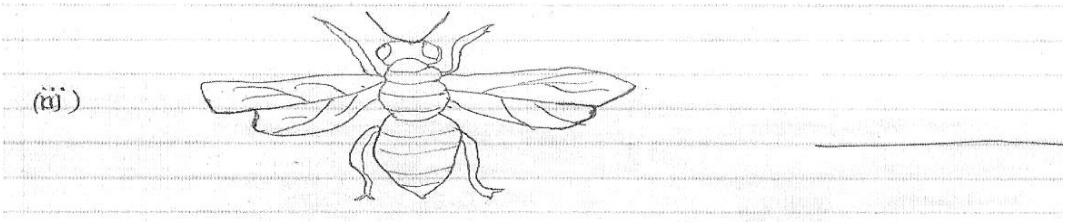
1. Feed the queen, drones and the brood.
2. Protect the hive from intruders.
3. Collect nectar, pollen, tree resins, gums and water.
4. Build combs and seal the cracks and crevices in the hive.
5. Clean the hive.
6. Make honey and bee wax.



Queen.



Drone.



Worker Bee.

Life cycle and work of a Bee.

- Fertilised queen moves from one cell to another laying an egg in each.
- In the warmth and moisture generated by a cluster of worker bees, eggs hatch after 3 days.
- Larvae are feed by nurse bees on special pulp, then on a mixture of pollen and honey.
- Each larvae spins a cocoon and after 2 days moults into a pupa.
- Pupa becomes a young bee after 10 days and emerges from the cocoon.

N/B.

21 days –worker bee.

24 days- drones.

15 days- queen.

SITING THE APIARY.

Apiary. Where beehive are laid.

Factors to consider.

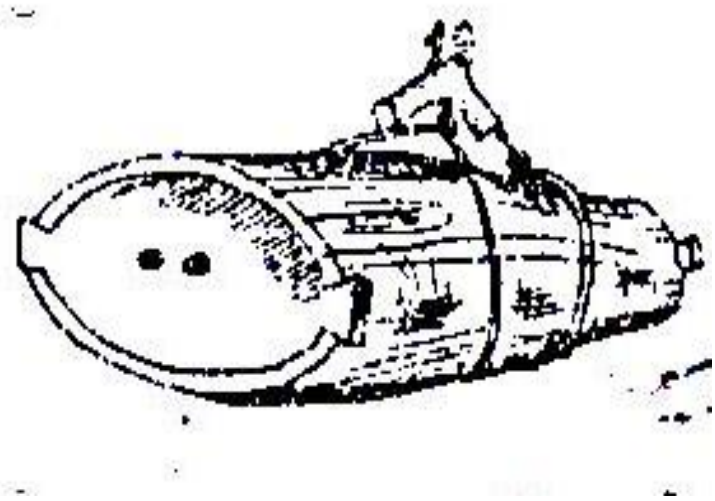
1. Availability of water within a radius of 3 km or otherwise place water in containers near the hive with sticks floating on the water to prevent bees from drowning.
2. Availability of flower for nectar.
3. A sheltered place protected from sun and wind.
4. Free from noise and other disturbances.
5. Away from human beings and livestock that is, away from homestead, pastures and busy roads.

Types of Bee Hives.

Log Hive.

Made of a log spilt into two parts.one side is larger than the other. The inner material from the larger portion is scooped out to leave a hollow space. The smaller portion forms the floor of the hive. The two portions are then joined together using wire strings.

The hive is suspended by means of wires from a tree or a pole.



Box Hive.

Holes are drilled for ventilation and entrance of bees. These are drilled in the bottom board.

The top side and end board are nailed together while the bottom board is attached by use of wires.

Kenya Top Bar Hive.

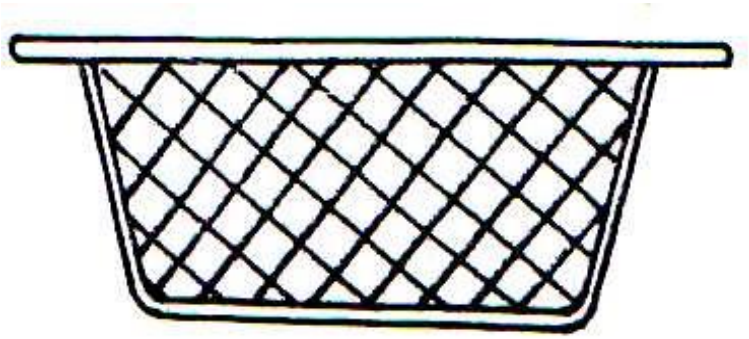
Has a series of bars arranged to form the top of the hive. Bees attach their combs on the top bars.

Consist of 27 bars but one may be replaced with a feeder box for feeding bees.

Another top bar is replaced with a queen excluder.

Queen excluder.

Restrict the queen from laying eggs on all the top bars, thus ensuring high quality honey that is not mixed with the brood.

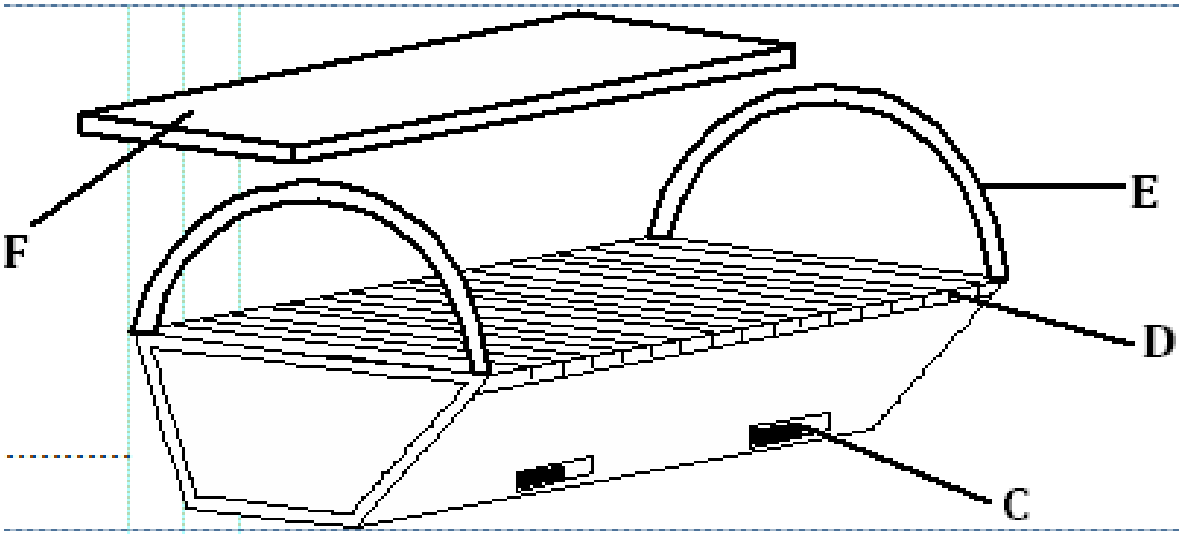


Queen excluder.

Top bars contain a strip of bee wax starter along the centre to guide bees to build their combs straight.

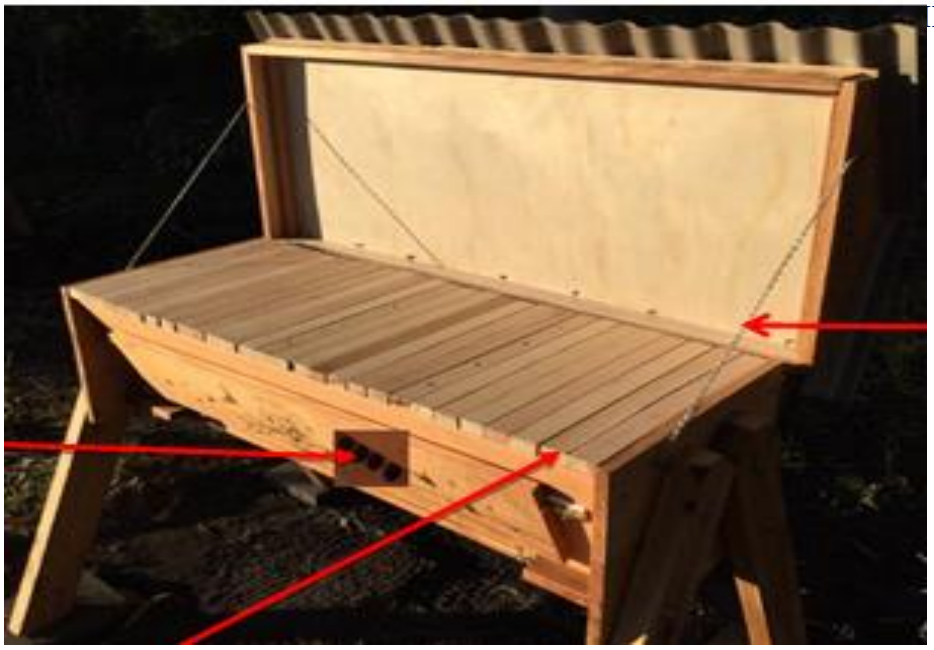
The sides of the hive should be sloping at an angle of 110-120 so that bees do not attach their combs to the hives walls.

Parts of Kenya Top Bar Hive.



Kenya Top Bar Hive.

1. **25-27 top bars.** 3.2cm wide by 48cm long.
2. **Wooden end piece.** 2 for each side. 48cm wide at the top and 23cm at the base and 30cm high. (48x23x30)
3. **Side pieces.** 2 measuring 30cm wide and 90 cm long. Bear holes that serve as entrance to the hive.
4. **Bottom piece.** 1 measuring 30 cm wide and 92 cm long.
5. **Top cover.** Made of corrugated iron sheet with a wooden rim. Measures 96 cmx 55cm.
6. **Wire loop.** On both sides to suspend the hive above the ground.



Advantages of KTBH.

- Top bars can be removed for inspection of combs and replaced.
- Honey combs can be removed without disturbing the brood.
- Production of high quality honey as it is not mixed with brood combs.
- More wax is harvested as combs are not returned to the hive.
- Cheap to build and does not require expensive equipments.
- Queen excluder can be used in the centre of the hive to separate honey from the brood thus increasing quality of honey.

The langstroth Hive.

Designed with separate chambers for the brood and the honey.

Each chamber is a separate box and can be placed on top of each other to form a storey of many chambers.

Queen excluder is placed in between the chambers.

The bottom board forms the floor of the hive while the top board forms the roof of the hive.

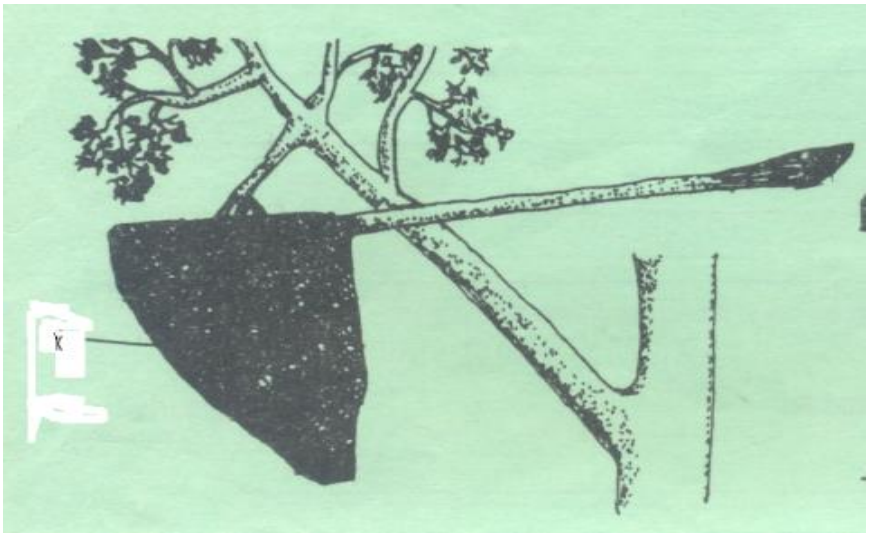
STOCKING THE HIVE.

Act of encouraging bees to enter an empty hive or actually putting them in it.

Methods of stocking the hive.

1. **Use of a swarm net.**

Made by fixing a strong wire ring to a bamboo pole. A piece of mosquito netting is sewn onto the ring. Trapped bees are then transferred to a hive.



2. **Use of a catcher box.**

Small hive that is moveable. Kept where it is likely to attract bees.

Old combs and wax are placed in the box to attract bees which are transferred to the main hive after a week.

Bees on a sloping surface always move upward thus the hive should be placed at higher position the catcher box.

MATERIALS COLLECTED BY BEES.

1) **Nectar.**

Juice collected from flowers. It is swallowed by worker bees, acted upon by enzymes in stomach and regurgitated back and stored in combs.

2) **Pollen.**

Collected from flowers. Collected with special “pollen baskets” on the feet. Contains 30% protein.

3) **Propolis.**

Bee product collected from trees and used to fill cracks and crevices in the hive. Has medicinal properties in human.

4) **Water.**

Water is put into containers and placed near the hive. Pieces of sticks or barks are floated on the water to prevent drowning of bees.

FEEDING BEES.

Reasons for feeding bees.

- To maintain the colony. To avoid swarming of bees.
- To encourage multiplication. Well-fed queen breeds regularly.
- To supplement what bees get from flowers during the dry season.

PESTS, DISEASES AND THEIR CONTROL.

Ants.

Makes holes in the hive which allows water into the hive causing rotting which allows honey badgers.

Control.

- Avoid contact between a plant and the hive.
- Suspend the hive between poles with the wires and post coated with old engine oil to keep off ants.

Wax moth.

Larvae of wax moth hatch from eggs laid in cracks. Have a protective greyish web.

Makes tunnels in combs and contaminate honey with their excreta.

Control.

- Remove and burn all infected combs.
- Old combs or wax left after harvesting honey should immediately be melted.

Bee louse.

Parasite of bee.

Control.

- Smoke out the hive with a smoker containing creosote to control the parasite.

Honey Badgers.

Spoils the hives and eat honey.

Control.

Hung the hive with wires so as to discourage the badgers as they fall off when the hive swings.

Diseases.

Acarive and American foul Brood. Controlled by proper feeding and proper construction of the hive to prevent damp conditions.

SWARMING OF BEES.

Swarm of bees. Colony or part of it that is in flight.

Causes.

1) Shortage of food and water in their surroundings.
2) Outbreak of diseases and parasites.
3) Damage of brood combs.
4) Lack of adequate ventilation.
5) Dampness and bad smells.
6) Sick or infertile queen.
7) Overcrowding.

Nuptial flight. First flight where mating takes place.

Absconding. Where some cluster of bees leave the hive because of unfavourable conditions.

Handling of bees.

- Bees should not be frightened as doing so makes them wild and sting.
- Do not approach the beehive from the front.
- A smoker must be used properly.
- Do not crush bees during handling as it excites the whole colony.
- Movement towards the hive should be made quietly to avoid alerting the bees.
- A bee sting should not the rubbed. Pressing causes the poison bag to release more poison.
- Wear protective clothing. That is, veil, an overall, gloves and gumboots.

HONEY HARVESTING.

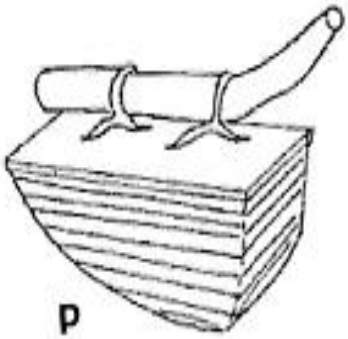
Honey is harvested when bees are less active. However do not harvest honey as night as it may lead to destruction of brood combs as visibility is poor at night.

Procedure of honey harvesting.

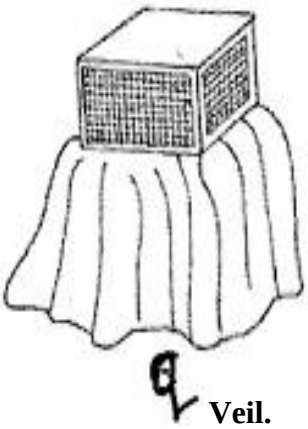
- Approach the hive quietly and blow smoke around the hive and later through the entrance holes using a smoker.
- Lower the hive to the ground.
- Using a hive tool separate the top bars from each other.
- Cut the combs 3 cm from the surface of the combs. The 3cm left is for attachment of new combs.
- Place back the bars and do not disturb the brood. Return the top cover.
- Return the hive to its position.

Equipments used in Harvesting Honey.

- Protective gear.



Smoker.



Veil.

- Honey container with a tight cover to hold the honey combs being harvested.
- A hive tool. Tom scarp away Propolis holding the top bars together.
- Bees brush. To brush off bees from the honey coms before cutting and putting into the container.

HONEY PROCESSING.

1) Using heat to melt the honey.
2) Crushing and straining method.
3) Using a centrifugal extractor.

Heat method.

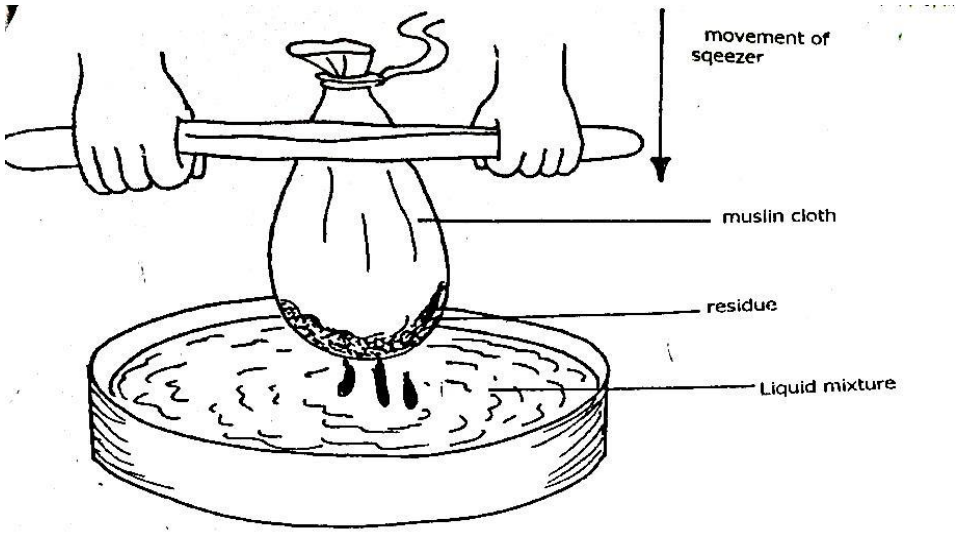
- Heat some water in a sufuria.
- Put honey combs in an enamel basin or any container not made of iron.
- Put the container with honey combs into the boiling water.
- Heat until most of the honey melts.
- Separate the melted honey from the combs by straining through a muslin cloth.
- Keep honey in a container to cool down.
- Remove the wax layer the may form on the surface of honey.

Crushing and straining method.

This produces the highest quality honey.

- Honey combs are crushed and strained using a muslin cloth into the enamel basin.
- The scum formed is removed with a wooden spoon.

- Honey is put in a suitable container.



Using a centrifugal extractor.

Used for large scale production.

Rotary motion forces out honey and combs are left clean.

Bee wax.

Wax is secreted by a pair of glands in the abdomen of the worker bee.

It is used to make combs.

Uses of processed wax.

- Manufacture creams, ointments, candles, shoe and floor polish.
- Used in dissection of small insects.
- Used to make pill coatings.
- Used to make teeth impressions for filling and replacement.

Procedure of wax processing.

- Put combs (with honey extracted) into a basin.
- Add water to the basin.
- Heat the mixture until wax melts.

- Strain the mixture through a muslin cloth.
- Squeeze the residue strongly to force wax out.
- Cool the mixture overnight.
- Drain the water and remove any foreign particles.
- Re-melt the wax over a water bath and put it in a clean container.

Marketing of honey and wax.

Factors determining quality of honey.

- Type of plants from which nectar was obtained.
- Maturity stage of honey at the time of harvesting.
- Method of harvesting.
- Method of processing honey.

FISH FARMING. (AQUACULTURE)

Importance of fish farming.

- Supplies cheap and good source of proteins which is a good substitute for meat.
- Requires little land hence practiced even where land is a limiting factor.
- Source of income for fish farmers.
- Makes fish available nearby.

Species of fish farmed in Kenya.

Fresh warm water fish.

18 degrees Celsius. E.g. Tilapia, Nile perch and Cat fish.

Fresh cold water fish.

10-15 degrees Celsius. Requires water that is always flowing. E.g. Trout.

REQUIREMENTS FOR FISH FARMING.

1. **Water supply.**

Water flowing freely is suitable .flowing water in and out ensures enough oxygen supply.

2. **Slope of the land.**

Should have a gentle slope. Flat land does not allow free flow of water.

Hilly places are expensive to construct a pond because dykes are needed.

3. **Soil.**

Clay soil is suitable as it does not allow water to seep through.

How to test soil suitability.

1. **Method one.**

   - Take a handful of wet soil.
   - Knead in between the fingers and roll it into a ribbon.
   - Throw into the air and catch it.
   - If it does not break it is clay soil.

2. **Method two.**
   - Dig a Hole 1M deep and 30cm in diameter.
   - Fill it with water in the evening and leave overnight, then fill it again in the morning.
   - Good soil should retain water up to the evening.

CONSTRUCTING INLET, OUTLET AND SPILLWAY.

1. **Inlet.**

Canal/pipe at the entrance of the pond.

Screen or fine mesh is made across the inlet to prevent entrance of undesirable/strange species of fish.

2. **Outlet.**

Made at the deeper end of the pond just a little above the bottom of the pond.

Screen is fitted at the mouth to prevent fish swimming away.

3. **Spillway.**

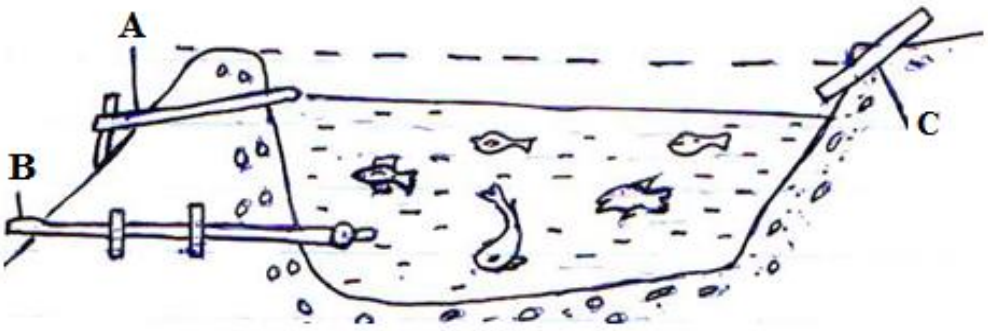
Channel that allow excess water back to the river.

Made at the top of the dyke on lower side of the pond.

Prevents water from overflowing on the dykes.

Grass is planted on the dykes and land around it to stabilise the ground.

The pond is fenced all round to keep off predators and unauthorised persons.



ESTABLISHING A FISH POND.

Procedure.

1. **Site selection.**

Select a suitable place where water flows gently from the source.

2. **Site marking.**

Pegs are used to mark the channel from the river, the entrance and exit and the channel to take water back to the river.

3. **Clearing the land.**

All vegetation is removed and taken away from the pond area.

4. **Digging the pond.**

Soil is dug out. The top soil is placed separately. Upper portion of pond is 0.5M deep and lower side 1.5 M deep.

5. **Constructing the dyke.**

Wall constructed all-round the pond.

STOCKING THE POND.

Fingerlings are introduced to the pond.

They are transported in oxygenated polythene bags, drums etc.

Water in the container should be clean and at a temperature of 10 degrees Celsius.

Fingerlings are introduced into the pond by lowering the container into the water and tilting it to allow them to swim away. For every $5M^2$, 5-10 fingerlings are introduced.

FEEDING FISH.

Feed on planktons.

Other feed include: kitchen waste, leaves, chicken manure.

Give just enough food as excess can rot and pollute the pond.

Any change in food type should be gradual.

Manure and fertiliser should be added to the pond to encourage growth of planktons.

CROPPING AND HARVESTING OF FISH.

Cropping.

Removal of sizeable and marketable fish from the pond.

- **Hook and line.** Baited hooks are lowered into the water. Commercially as fishing lines.
- **Use of nets.** Nets of different meshes are used. Seine nets in East Africa have a size of 3.0-3.5 cm.

Merits of using seine net over hook and line.

- Only marketable size of fish are caught as smaller ones swim back to the pond if caught.
- Fish are not injured.
- Ensure large number of fish are cropped.

Harvesting.

Removal of all fish from the pond.

The pond is drained and all fish are removed.

Procedure of harvesting fish.

- Inflow of water from the river is stopped by closing the channel leading to the pond.
- Normal cropping is done to remove all the large fish by use of a seine net.
- The outlet is then opened to allow water to flow out.
- A scoop net is used to catch the fingerlings which are kept in a holding pond.
- Water is completely drained for the pond to dry up.
- Maintenance of pond is carried out and fingerlings taken back to the pond. (Restocking)

Maintenance of the pond.

- Repairing the dykes or any structure on it.
- Cleaning the pond and removing all foreign materials.
- Planting grass where necessary.
- Removing undesirable vegetation.
- Removing silt.

FISH PRESERVATION.

Activities before preservation.

- Cleaning the fish to remove mud and any worms.
- Removing scales and slime.
- Opening the fish on the side to remove the gut and the intestines. (Gutting)
- Cleaning the abdomen/cavity thoroughly.
- Keeping fish in open containers.

METHODS OF FISH PRESERVATION.

1. **Freezing.**

Keeping fish in deep freezers.

2. **Salting.**

Fish are kept in salt solution or rubbing granular salt on the fish.

3. **Sun-drying.**

Fish is dried under strong sunlight. It is spread on racks or mats to dry.

4. **Smoking.**

Done by exposing fish to temperatures of 70 degrees Celsius in smoking houses.

CHAPTER THREE.

FARM STRUCTURES.

Farm structure.

Any physical construction found on the farm.

Construction of farm structures.

Involves: planning, site preparation and selection of materials.

Panning for farm structures.

Factors to consider.

- Various farm activities to be carried out.
- Size of the enterprise.
- Potential for expansion.
- Accessibility.

SITING FARM STRUCTURES.

Factors to consider.

1. **Location of the homestead.**

Should be sited at a point where it would be possible to have a good view of the farm.

2. **Accessibility.**

Structures should be easy to reach from most parts of the farm.

3. **Security.**

Structures should be safe from predators, thieves and trespassers.

4. **Drainage.**

Should be in a well drained area to prevent destruction by water. Damp conditions encourages disease infection.

5. **Direction of prevailing wind.**

Structures where foul smell is likely to occur should be constructed on leeward side of homestead. Others requires good ventilation but free from draught.

6. **Relationship between structures.**

Structures with related uses should be constructed close to each other to save time and labour.

7. **Farmers taste and preference.**

E.g. some prefer to have the homestead in a sheltered placed.

8. **Proximity of amenities e.g. electricity and water supply.**

Homestead should be located near power line and water supply.

9. **Topography.**

Most requires a relatively level site. Slopy site is expensive as it requires levelling.

Site preparation.

Involves clearing of bush and levelling of the site.

CONSTRUCTION MATERIALS.

Types of materials.

1) **Stones.**

Advantages.

- Durable.
- Resistant to weather elements.
- Fire resistant.
- Resistant to insect damage and rotting.

However stones are expensive to acquire and slope.

Stones are used for foundations, floor and walls.

2) **Concrete blocks.**

Made of cement: sand: ballast 1:2:3 by volume.

Water added should be controlled so that the blocks are not very dry or wet.

Water should not have impurities such as acids, bases or oils. They reduce binding ability of cement.

Blocks are placed under shade to enhance gradual curing.

Should be wetted during curing.

Advantages.

- Durable.
- Resistant to fire insect damage and elements of weather.
- Resistant to rotting.

3) **Concrete.**

Prepared from aggregate: sand: cement 3:2:1.

Use water free from impurities.

Uses.

- Making pillars, blocks, posts, surveyor's beacon.

Concrete floors should be kept damp during curing.

Concrete is reinforced with steel rods or welded wire and compacted when being used to enhance strength.

Advantages.

- Strong and durable.
- Resistant to insect damage, fire, rotting and weather elements.

4) **Mud blocks.**

Made up of a mixture of clay and sand thoroughly puddled with water.

N/B.

- Chopped grass is incorporated to enhance strength of blocks.
- Blocks are dried in open sun but covered with dry grass.
- To enhance durability, walls should be plastered with mortar (sand and cement mixture)

5) **Bricks.**

Prepared using special type of soil with high amount of clay.

Are dried and then baked in a kiln. They make durable structures if well joined with mortar.

They are resistant to fire and insect damage.

6) **Metals.**

a) **Corrugated iron sheets.**

Used in making walls and roofs. Supported on wooden or metal frames.

Advantages.

- Durable.
- Leak proof.
- Resistant to insect damage.

b) Bars and rods.

Posts, iron rods, wires and frames.

Iron rods are sued to reinforce concrete.

Metal frames are used to make trusses, windows, doors and gates.

c) Aluminium sheets.

Used for making prefabricated structures, gates, doors and windows. Also used to make feed troughs and waterers.

d) Construction accessories.

Includes: metal hinges, screws, nuts, bolts and latches. Used for assembling structures.

7) Timber.

Uses.

- Poles, rails, purlins, rafters, struts and beams in construction works.
- Sawn timber used for floors, celling, fascial board.

Timber should be treated to make it resistant to insect attack, weather elements and fungal attack.

Methods of treating timber.

Drying/seasoning.

Dried to reduce moisture content. Dry in a shaded place away from direct sunlight and rain.

Reasons for seasoning timber.

- Prevent warping.
- Prevent rotting due to fungal attack and insect damage.

Chemical treatment.

a) Fungal attack.

Sodium dichromate, copper sulphate and arsenicpentoxide.

b) Insect damage.

Old engine oil, pentachlorophenol tributyl tin oxide.

c) Weather elements (humid conditions)

Creosote, tar, tanex.

CHEMICAL TREATMENT METHODS.

a) **Sap displacement method/end diffusion.**

Fresh cut posts are packed in containers filled with wood preservatives and left to stand in the containers for 10 days.

The preservative is drawn through the wood grains as the sap dries out.

b) **Pressure/vacuum treatment.**

Peeled wood is arranged in steel cylinders and the preservative forced through them under very high pressure.

c) **Hot and cold soaking.**

Wood is immersed into a tank containing creosote or other preservative heated for two hours and heat maintained just below boiling point.

Moisture in the wood cells expand and contract once heat is removed.

Contraction draws the preservative deep into the wood fibres.

8) **Thatch**.

Used for roofing. Made from coconut leaves, tall grass/papyrus reeds etc.

Limitations.

- Prone to fire.
- Prone to insect damage hence require regular replacement.

9) Tiles.

Made from clay or a mixture of clay and sand.

Used for roofing, decorating walls and floors.

Merits.

- Durable.
- Resistant to insect damage, weather elements and fungal attack.
- Are good insulators.
- Makes structures attractive.

However if poorly made, they absorb a lot of water, becomes eroded hence begin leaking.

10) Bamboo and sisal poles.

Used as rails, rafters and droppers in fences.

Used for internal decorations.

11) Plastics.

Used as water pipes, conduits during wiring and construction of green houses.

SELECTION OF CONSTRUCTION MATERIALS.

Factors to consider.

- Availability of materials.
- Cost of the materials.
- Suitability of the materials.
- Suitability to prevailing weather conditions.
- Durability of the materials.
- Strength of the materials.
- Workability of the materials.

TYPES OF FARM STRUCTURES.

Farm building.

Building is a structure that consist of the foundation, walls and the roof.

Importance of farm buildings.

- Protect the farmer and livestock from predators.
- Help in the control of livestock diseases and parasites.
- Provide shelter against extreme weather conditions.
- Provide storage of farm produce and other variable inputs.
- Increases the efficiency of production and management in the farm.

PARTS OF A BUILDING.

The foundation.

Part of the building that is constructed below the ground.

The foundation helps to evenly distribute the load of the building.

The foundation should be reinforced with concrete especially in humid waterlogged areas.

Drainage channel is installed to prevent undermining the foundation by water.

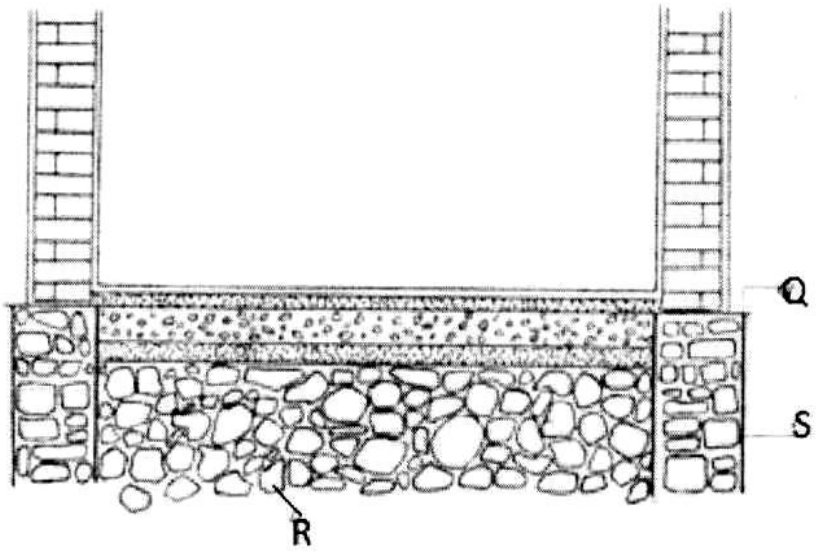
Establishment of the foundation.

Foundation is measured, pegged and dugged to remove all loose soil.

Concrete of ratio 1:2:4 or 1:3:6 (may be reinforced with steel rods) is placed in the trench, compacted and the foundation stone laid up to about 15cm above the ground level. Mortar (1:6) is used to join the foundation stones.

Role of PVC course.

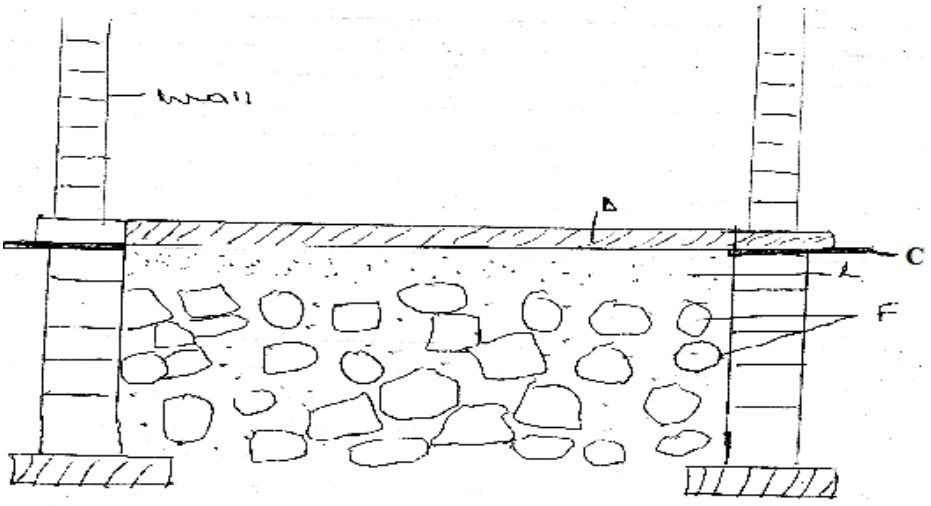
Reduce termite and moisture rising up the wall.



Foundation floor.

Part of the building laid immediately after foundation wall.

Filled with stones/hard core and rammed/compacted to make it firm and a concrete slab 1:2:4 cement: sand: aggregate used.



Walls.

Forms outer vertical part of the building.

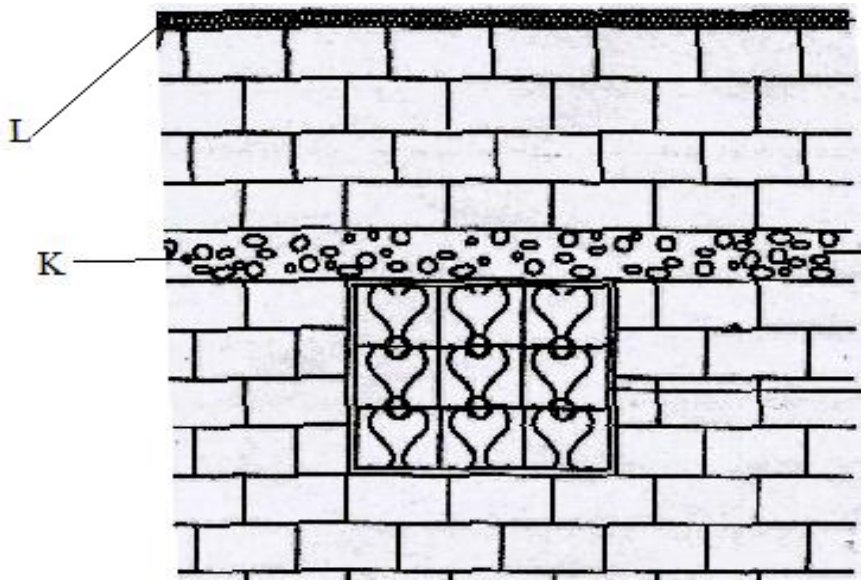
Wall is raid in direct contact with the PVC material.

Bricks should not overlap to form straight joints that create weak points.

Plumb bob and spirit level are used to ensure it is vertical.

Lintel is built to reinforce wall above windows and doors.

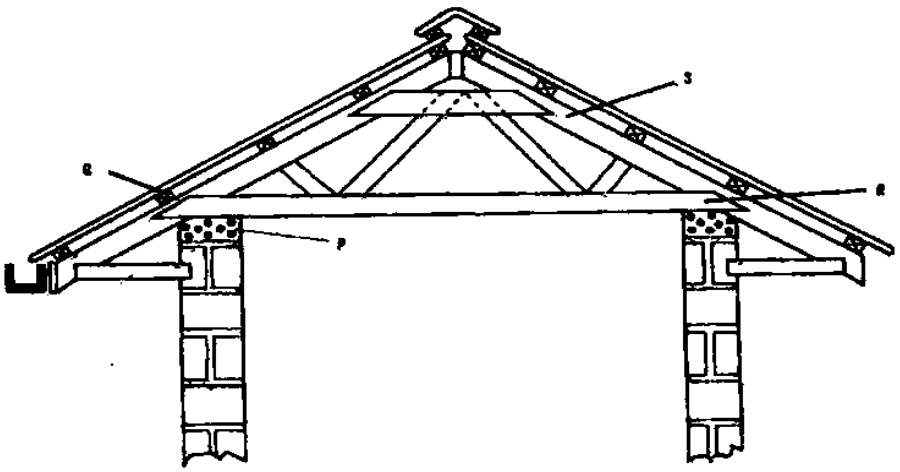
4 courses are laid after the lintel then the wall plate is laid.



The roof.

Consist of a framework of trusses and purlins on which the roofing material is placed.

Trusses should be well constructed to avoid collapsing of the roof.



Parts of a roof.

Truss.

Made up of a tie or beam as the base, two rafters above the base to form a triangular structure and a number of struts for support.

Truss may be made of wood or steel bars.

Trusses for large buildings are prepared on the ground before they are hosted.

After hosting, purlins are nailed horizontally on the rafters.

Pitch/rise.

For grass or tiles rise should be 40 degrees to let water run off easily. The height of the truss above the wall plate in this case is half the length of the width of the house.

For corrugated iron sheet the truss is a quarter the width of the house.

Establish a straight line at the lowest end of the roof by putting a string so that roofing materials are laid on a straight line.

LIVESTOCK STRUCTURES.

Crush.

Narrow fenced passage where livestock movement can be controlled.

Used in routine management practices such as:

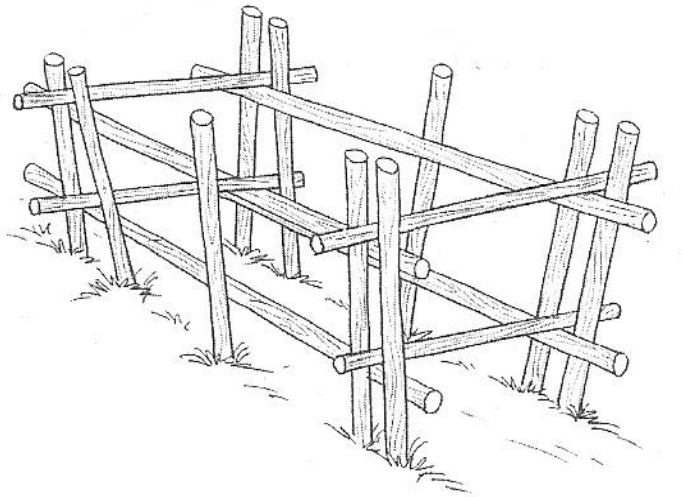
- Spraying livestock against external parasites.
- Identifying animals.
- Vaccination.
- Administering prophylactic drugs.
- Treating sick animals.
- Dehorning.
- Pregnancy test.
- Taking body temperatures.
- Hoof trimming.
- Milking.

Materials for construction.

Posts, rails, nails and concrete.

Posts and rails should be treated with old engine oil.

Parts of post to be fixed in the ground may be charred (partially burned) to prevent termite attack.



Factors to consider siting a crush.

- **Topography.**

Should be well drained and relatively flat.

- **Accessibility.**

Should be next to livestock sheds in large farms or near the road where services are offered by the government.

Maintenance.

Any broken parts should be repaired or replaced.

Dips.

Used for tick control.

- Plunge dip.
- Machakos dip.

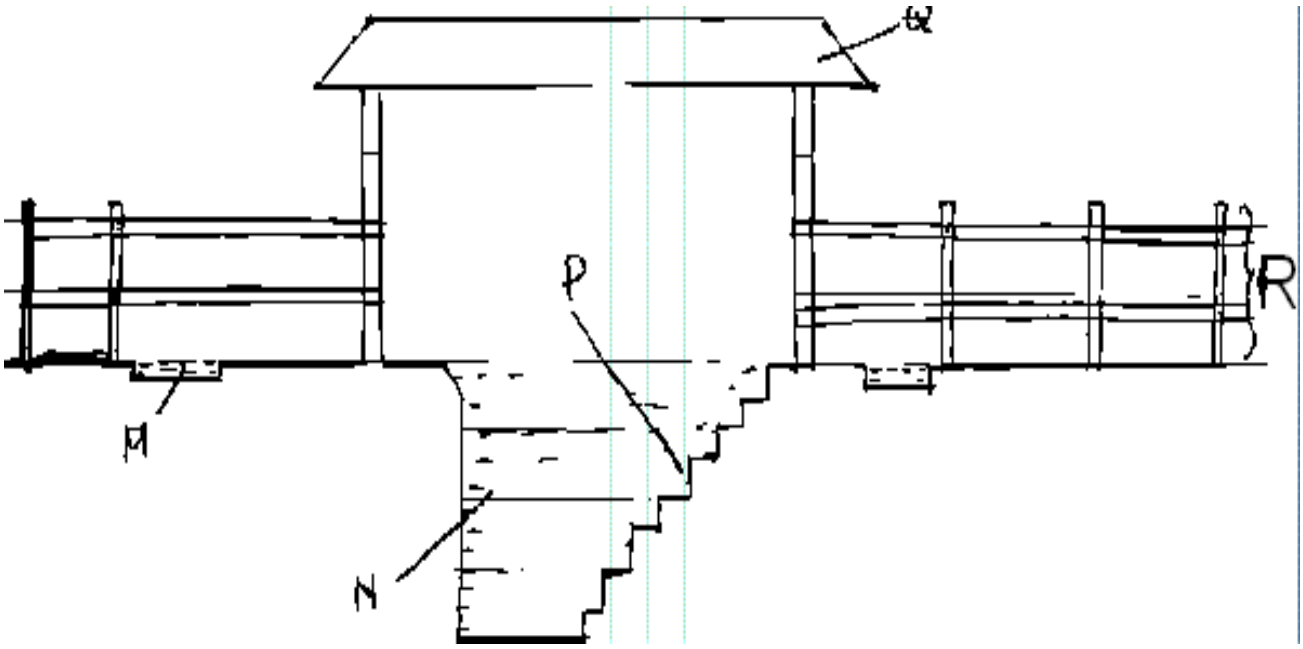
Parts of a plunge dip.

1) **Animal holding yard.**

Holding animals before dipping.

Should allow $2m^2$ per head of cattle.

Should have a concrete floor and stones to help in removing mud from hooves befoe getting into the dip wash.



2) **Foot bath.**

Next to the animal holding yard.

4M long and 20CM deep.

Purpose.

- To wash feet of animals before getting into the dip wash.
- Contains chemicals for controlling foot rot. E.g. copper sulphate (blue vitriol) at 5-10% or 2-5%$ formalin solution.

3) **The jump.**

Narrow entrance to the dip tank with short steps.

Allows animals to jump singly into the dip tank.

Should be 35-45CM above the dip wash level to ensure maximum immersion and allows dip wash to splash back.

4) **Dip tank.**

Deep tank constructed below ground level.

Measures 5M long at the bottom, 8M at the top and 1.6M deep at the highest level of acaricide. (10,000 litres of dip wash).

Should have exit steps that allows animals to come out of the dip wash slowly.

5) **Drainage race.**

Has a sloping floor towards the dip tank to allow dip wash from animals to drip back to the dip tank.

6) **Drying yard.**

Prevents pasture contamination and also ensures all the animals are released at the same time.

7) **Silt trap outlet.**

Trap silt before it flows back into the dip tank. This prevents siltation preventing regular washing.

8) **Dip tank shelter.**

Constructed above dip tank to lower evaporation of dip wash and dilution of dip wash by rain water.

It also acts as roof catchment for collecting rainwater.

9) **Water tank.**

For storing water used for dipping purposes.

10) **Waste pit.**

Used as a dumping site for sediments from dip tank.

Prevent environmental pollution by acaricide.

The 'Machakos' Dip.

Suitable in areas with water and capital scarcity.

Suitable where the herd is small.

Similar to plunge dip but dip tank is smaller and animals walk down the steps and stands in the deepest part where the belly and underside are beneath the wash then dip wash is poured over the rest part using buckets.

Construction materials.

- Cement, sand, ballast and hardcores.
- Stone blocks.
- Corrugated iron sheets and galvanised sheets.
- Posts and rails.
- Nails, screws and hinges.
- Wood preservatives.
- Bolts and nuts.

Maintenance.

- Broken timber rails should be replaced.
- Dip tank should be cleaned regularly removing all sediments.
- The roof should be maintained to ensure they are leak proof.
- Cracks in the various parts should be repaired.

Advantages of using a plunge dip.

- Animals are completely immersed in dip wash ensuring the whole body is wetted hence more effective in tick control.
- Suitable for large herds of cattle.
- Has low operational cost.

Disadvantages of plunge dip.

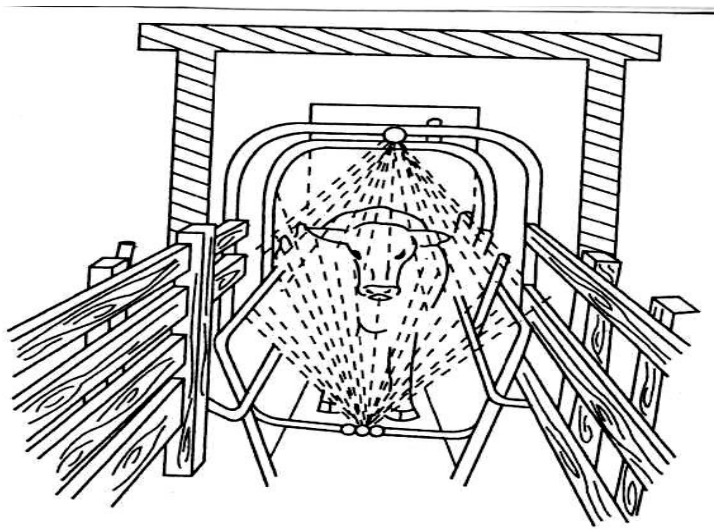
- Not suitable for heavy, pregnant or sick animals as they may get shock.
- Animals may swallow some of the dip wash resulting in death.
- High initial capital.

The spray race.

Animals are showered with acaricide from nozzles as they pass through narrow passage, the race.

Acaricide is drawn by a centrifugal pump driven by an engine of tractor PTO shaft.

PARTS OF SPRAY RACE.



1) **Sidewalls.**

Provide support to the piping system and ensures spray wash is directed back to the pump via the drainage pipe.

2) **Spray pipe system.**

Consist of a series of pipes fitted with nozzles at regular intervals, nozzles atomise the chemical into spray form.

3) **Drainage pipe.**

Conducts the used chemical back to the pump for re-cycling.

Fitted with sieves to filter sediments thus preventing blockage of nozzles.

4) **Pump/reservoir.**

Mixing tank fitted with an agitator pipe and centrifugal pump.

5) **Pressure gauge.**

Measures the recommended working pressure of the pump.

Advantages of using spray race.

- Suitable for pregnant and sick animals than plunge dip as animals do not get a shock.
- No wastage of acaricide thus requiring less amount of acaricide as compared to plunge dip.
- Animals cannot swallow the acaricide wash.
- Spraying is faster.

- Less labour is required.

Disadvantages of spray race.

- High operational cost.
- Requires skilled labour to operate and maintain.
- It is only economical with large herd.
- In wet weather, nozzles tend to clog with dirt in the wash.

Maintenance.

- Broken rails should be replaced.
- Worn out floors should be repaired.
- Sump should be cleaned regularly removing all sediments.
- Blocked nozzles should be cleaned.

DAIRY SHED.

Used during milking.

Consist of:

- Milking parlour.
- Feed store.
- Calf pens.
- Equipments store.
- Recording room.

Should be constructed in a well-drained area.

Should have concrete floor for easy cleaning.

Parts of a milking shed.

1) **Milking stalls.**

For milking. May be fitted with head yokes used for other management practices.

2) **Feed store.**

Storing feeds. Feeding records are done here.

3) **Calf pens.**

Should be near milking shed to ensure milk is given to calves immediately after milking.

4) **Milk recording room.**

Fitted with weighing balance and a recording board.

5) **Milk store.**

For cooling milk after milking before being sold.

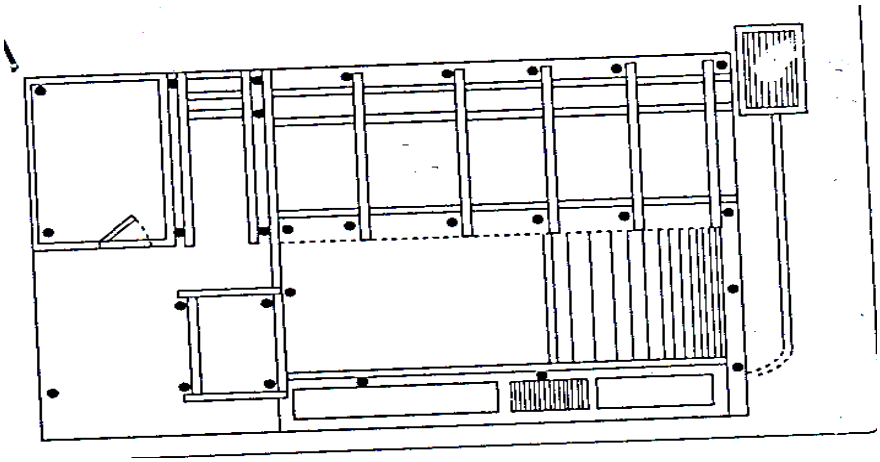
Materials for construction.

- Corrugated iron sheets for roofing.
- Posts.
- Rails.
- Cement, sand, ballast and hardcore.
- Nails, bolts and nuts.

Maintenance.

- Milking shed should be cleaned thoroughly after milking.
- Pot holes in the concrete floors should be filled.
- Broken rails should be replaced.
- Cooling system should be kept in good working conditions.

ZERO GRAZING UNIT.



Cattle remain in the structures for most of the time.

PARTS OF A ZERO GRAZING UNIT.

1) **Milking stall.**

For restraining cows during milking.

2) **Calf pens.**

For rearing calves up to weaning.

3) **Sleeping cubicles.**

Providing shelter to the animals. Should have litter to make them warm.

Should be bare (no concrete) to avoid chilly conditions at night.

Bare soil supplies micro-organisms that break down the bedding.

4) **Loafing area.**

Used for resting and dunging.

Should not be roofed for animals to obtain sunlight necessary for vitamin D synthesis.

5) **Feed and water troughs.**

For feeding and watering animals.

6) **Feed preparation room.**

For preparation of feed rations.

7) **Milk recording room.**

Used for keeping individual milk records for dairy cows.

Store.

Keeping dairy equipments such as milking bucket, strip cup, dairy feeds tec.

CALF PENS.

Structural requirements.

1) **Concrete floor/easy to clean.**

Makes cleaning easy.

2) **Adequate space/spacious.**

Large enough to allow room for exercise, feeding and watering equipments. 1.8MX1.8M

3) **Single housing.**

Prevents calves from licking each other leading to formation of hair balls in their rumen.

It also helps to control spread of worms and skin infection.

4) **Proper lighting/well lit.**

Front wall should be constructed solid 60-90CM high while the rest of the space is fitted with wire mesh.

This allows sunlight for vitamin D synthesis.

5) **Proper drainage.**

The area should be well drained.

Poor drainage causes dampness in the calf pen which predisposes the calf to infection.

May have slatted floor to facilitate drainage.

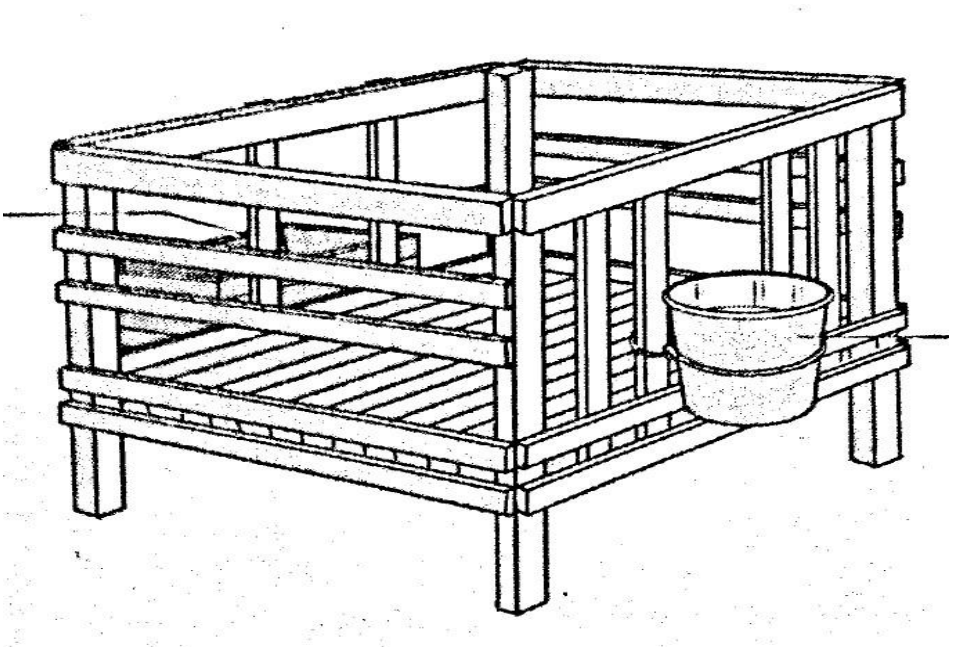
6) **Draught free.**

Windward side should be completely solid top to bottom to prevent entry of cold winds.

These predisposes the calf to pneumonia.

7) **Leak proof.**

To avoid wetness in the house. Wetness encourages infections such as pneumonia, naval illness and scours.



Raised calf pen with slatted floor.

Materials for construction.

- Timber posts and frames.

- Nails.
- Roofing materials.

Maintenance.

- Should be kept clean.
- Leaking roof should be repaired.
- Walls should be white washed instead of painting to prevent lead poisoning
- Should be kept dry and warm by placing dry litter on the floor which should be changed once a week.

POULTRY HOUSES.

Folds.

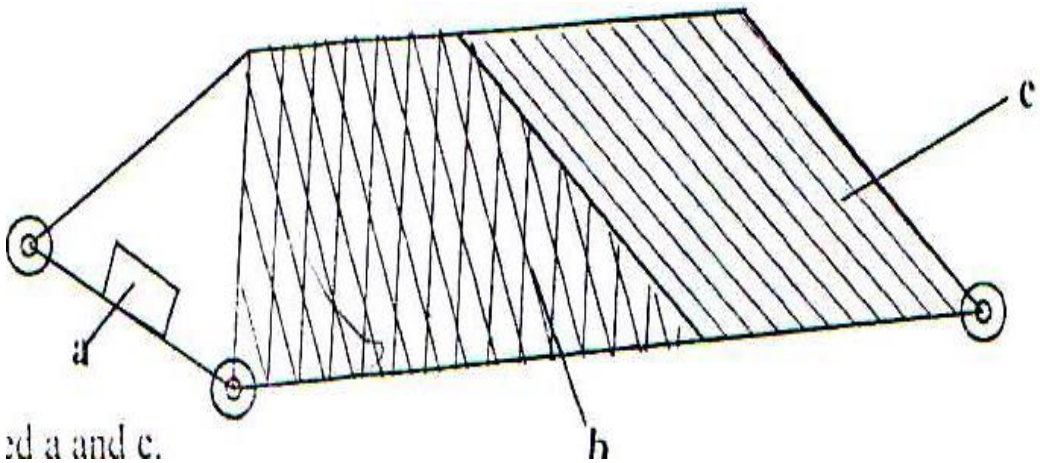
Birds are confined in small structures (arks/fold).

Fold measures 3,5Mlong X1.5M wideX1.5M high.

1 /3 of the fold is roofed to provide shelter and the rest is enclosed by a wire mesh. (For sunlight and exercises)

Should be moved daily to reduce disease and parasite build up.

Only a few birds may be kept.



ed a and c.

Night shelters and runs.

Used in free range system where birds are allowed to move freely in fenced enclosures (runs) and spend the night in shelters. (Laying nest are also in the shelter)

Raised on stands or hung on a tree to discourage predators.

Should preferably be movable to prevent disease and parasite build up.

Deep litter houses.

Houses in which birds are totally confined.

Structural requirements.

1. **Well ventilated.**

Leeward side should be solid up to 90CM from the ground while the rest is wire mesh.

2. **Leak proof.**

To avoid dampness in the house that encourages disease infection.

3. **Litter on the floor.**

15-30cm deep.

Helps to keep the house warm and dry by absorbing moisture.

4. **Draught-free.**

Windward side wall should be solid top to bottom.

5. **Enough space.**

To avoid overcrowding. Allow 2-3 birds per $1M^2$

6. **Proper drainage.**

Should be built in a well drained area to avoid dampness.

Battery cage system houses.

Birds are kept in battery cages fixed in the house 60-90 Cm above the ground and arranged in tiers so that droppings are easily disposed.

Coops.

Special cages for rearing hens while brooding.

Construction materials for poultry house.

- Roofing materials.
- Wire netting.
- Timber posts, off-cuts and rails.
- Cement, sand and aggregate.

- Nails, hinges and latches.
- Pre-fabricated battery cages.
- Stones or blocks.

Maintenance.

- Regular cleaning.
- Repair leaking roof, broken hinges and doors.

A PIGGERY UNIT.

Parts of a piggery unit.

1) **Feed store.**

For storing pig feeds.

2) **Records room.**

Keeping feed and weight records.

3) **Pig pens.**

Pigs are kept in pens according to age and sex.

Include:

a) **Farrowing pens.**

Used for farrowing and rearing piglets.

Provided with farrowing crates to prevent the sow from lying on the piglet and from eating creep feed meant for the piglet.

b) **Gilts' pen.**

For rearing young females up to service (12 months)

c) **Boars' pens.**

Houses the breeding boar.

Spacious enough to allow room for exercise and mating.

d) **In-pigs pens.**

Houses pregnant sows awaiting farrowing.

e) **Weaner's/ fattening pen.**

Houses piglets awaiting weaning and up to 6 months.

4) **Running yard.**

Extension of the pens. For dunging and basking.

5) **Water troughs/ drinking nipples.**

Watering points for the pigs.

Structural requirements of a pig's house.

- Should have a concrete floor for easy cleaning.
- Should be free from draught to prevent pneumonia.
- Should have adequate space.
- Should have a well drained floor.

Construction materials.

- Corrugated iron sheets.
- Cement, sand and ballast.
- Posts and rails.
- Nails and hinges.

Maintenance.

- The house should be kept clean.
- Should be kept dry and warm.
- Holes in the floor should be filled with concrete.
- Timber rails enclosing the runs should be replaced when broken.

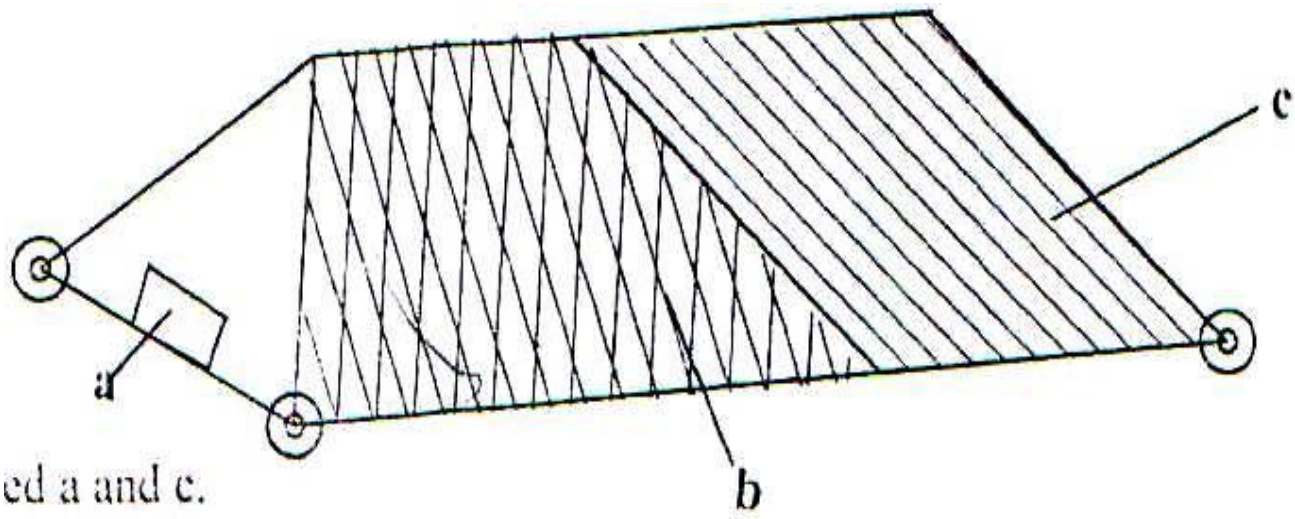
RABBITRY.

Structure for housing rabbits.

Morant cage.

Measures 2M long X 1M wide X 9M high. This is enough for a colony of 15 rabbits.

Wire netting on the floor, side and at the top except at corners for shelter.



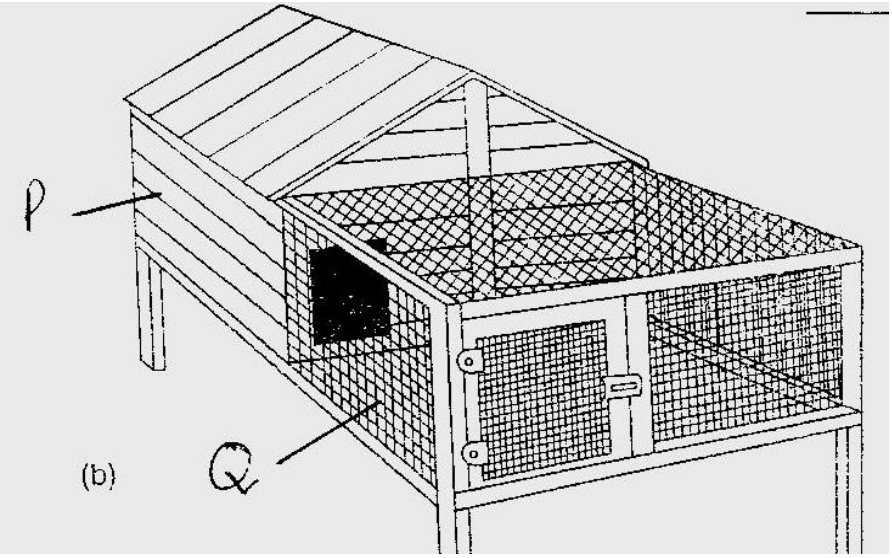
ed a and c.

Hutch.

Room for the doe with her litter or buck.

Measures 1M long X0.6 M wide X 0.4M high.

Should have sleeping and exercise yard.



Structural requirements.

- Large enough to allow space for feeding and exercise and sleeping.
- Should be raised 90-100CM above the ground to facilitate drying of bedding and prevent entry of predators and rats.
- Draught free but well ventilated.

Construction materials.

- Corrugated iron sheets or thatch.
- Wire netting.
- Posts, timber, rails and off-cuts.
- Cement, sand and ballast.
- Nails, screws, hinges and latches.

Maintenance.

- Should be kept clean and dry.
- Broken part should be repaired or replaced.
- Should be shaded in hot climate.

FISH PONDS.

Factors to consider in siting a fish pond.

1) **Source of water.**

Should be near a reliable source of water and the water should flow easily to the pond.

2) **Soil type.**

Clay soil is suitable. Sandy and loamy soils allows too much water seepage thus not ideal.

3) **Topography.**

Gently sloping to allow free flow of water tom and from the pond.

4) **Nature of land.**

Grounds with big cracks or with anthills are not ideal as they allow too much water to be lost.

Construction of a fish pond.

Pond walls are made by digging out soil from the pond floor and soil heaped on the sides.

Reinforcement (timber or stone wall) is important on the lower side wall that holds more weight of the pond. Walls should have a level top crest.

Dam crest.

Should be level. Pond bottom should be smooth so that fishing net are not torn while being dragged along.

Inlet furrow is dug to connect the water source to the pond and should be on the upper side.

Spillway on the lower side to allow excess water out and prevent water from flowing over the lower pond wall.

Grass is planted on wall side to firm the soil and prevent soil erosion.

Drain pipe on lower wall to drain water from the pond during cleaning or harvesting fish.

Maintenance.

- Planting grass on the wall tops to prevent soil erosion.
- Weeds growing around the pond should be removed.
- Fencing the pond area to keep off predators and other animals that pollute water.
- Cleaning the pond to remove foreign materials.
- Maintaining good level of water in the pond.

BEEHIVES.

Structures for housing bees.

Kenya Top Bar Hive.

Wooden box whose long sides slope inwards at an angle of 65 to prevent bees from attaching their combs to the sides of the hive.

Bees attach combs on the top bars.

Siting Beehives.

Factors considered.

- Should be placed away from homesteads, pastures and roads to avoid stings from bees.
- Should be in a sheltered quiet place away from disturbances.
- Provide shade or place hives under trees.
- Near a water source with flowering plants for nectar collection.

Construction materials.

- Timber.
- Nails.
- Posts.
- Corrugated iron sheet.
- Wire loops.

Maintenance.

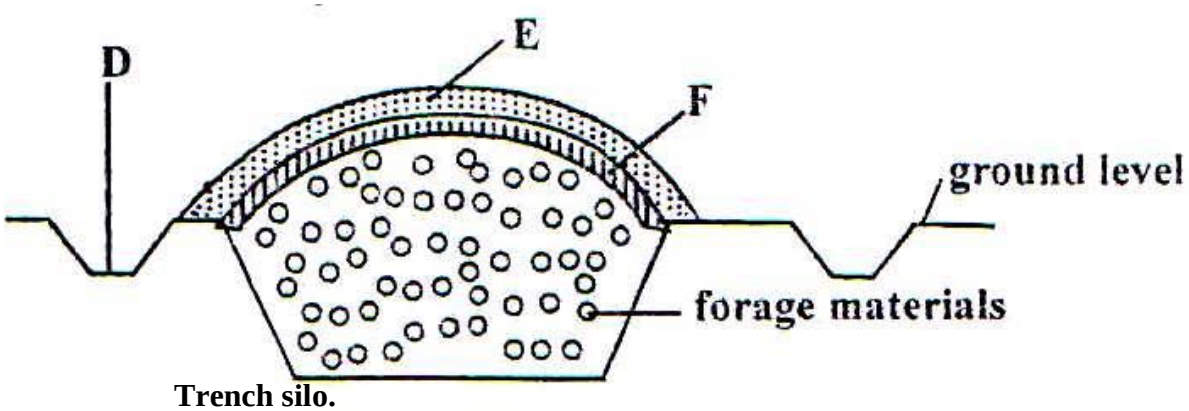
- Broken parts should be repaired or replaced.
- All cracks should be sealed.
- Grease on posts should be replaced if melted.

SILOS.

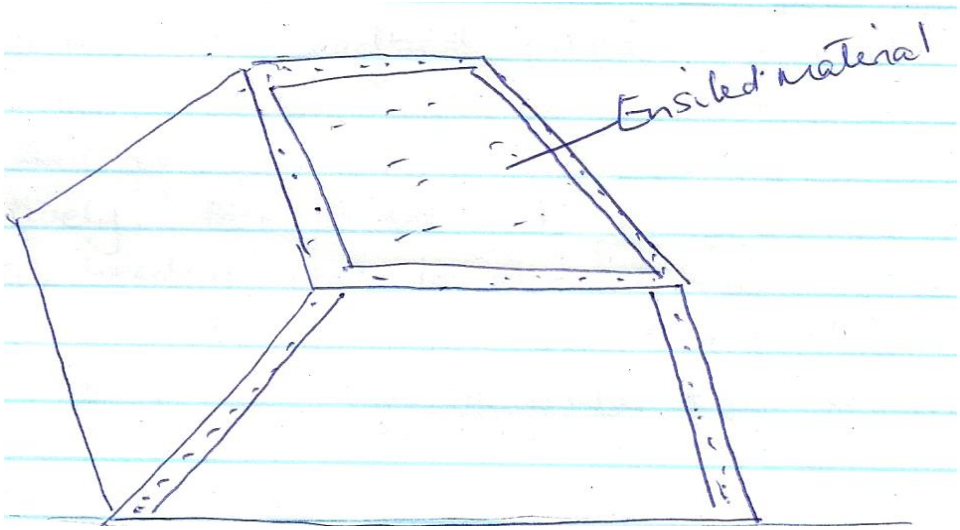
Used for preparation and storage of silage.

Include:

- Trench silo.
- Tower silo.
- Clamp or bunkers silo.



Trench silo.



Clamp silo.

FARM STORES.

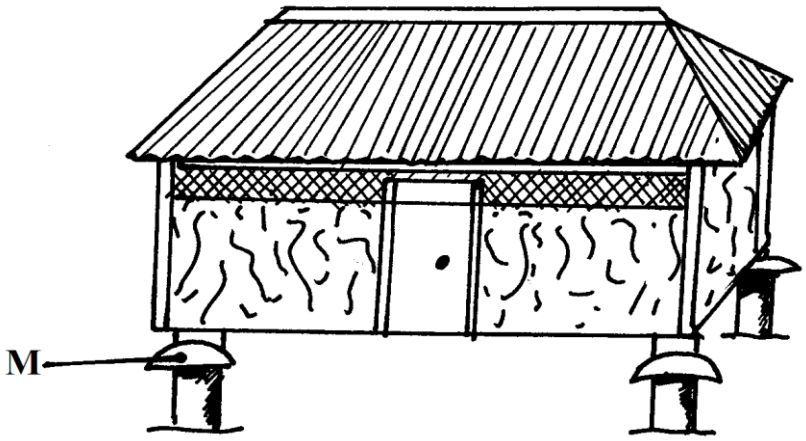
Structures used for storing seeds, feeds, farm tools, agro-chemicals and crop product.

Product stores.

Structures used to hold farm produce.

Includes:

- Traditional granaries.
- Modern store.
- Silo.
- Cyprus bin.



Modern store.

Structural requirements.

- Should be vermin proof. Rat guards/deflectors should be installed on all posts 50CM above the ground.
- Should be well ventilated. To avoid dampness.
- Should be water proof. To keep off rain water.
- Should be easy to clean. Should not have cracks or crevices where pests can hide.
- Raised 50CM above the ground to prevent dampness which causes rotting of grains.

Materials for construction.

- Posts, timber and rails.
- Hinges and laches.
- Poles.
- Strings and wires.

Maintenance.

- Vegetation around the store should be slashed to keep off vermin.
- Stores should be cleaned and disinfected regularly.
- Leaking roof should be repaired.
- Broken parts should be repaired or replaced.

Silos.

Structures for bulk storage of grains. Constructed above the ground. Have concrete, bricks, metal or wooden walls.

Cyprus bins.

Pits partially or completely underground with circular walls made of concrete or wood.

Structural requirements for grain silo and Cyprus bins.

- Properly constructed roof to protect crop from sun and rain.
- Walls should be plastered with mortar or mud to make them smooth and airtight.
- All inlets and outlets should be made of tight covers and should be easy to lock.

Maintenance.

- All broken parts should be repaired to avoid leaking.
- Any cracks in the surface of the walls should be sealed.
- The area around the silo should be kept clean by slashing vegetation to keep off rodents.
- Cleaning and disinfecting at regular intervals.

FENCES.

Uses.

- The perimeter fence constructed along the boundary demarcates the farm land from that of the neighbours.
- Fences keep off wild animals and other intruders from outside the farm.
- They are used to separate crop fields from pastures facilitating mixed farming.
- Used to divide pastures into paddocks facilitating controlled grazing systems.
- Controls movement of animals and people preventing formation of unnecessary paths in the farm.
- Helps to control spread of parasites and diseases by keeping off wild and stray animals from the farm.
- Enables the farmer to control breeding by rearing different animals in different paddocks.
- Provide security to the homestead and farm animals.

Types of fences.

- Live fences.
- Dead fences.

Live fences.

Made of growing plants.

E.g. kei apple, crotons, cypress, cacti, sisal, Euphorbia, bougainvillea, tick berry.

Advantages of live fences.

- Cheap and easy to establish since seedlings can easily be raised in a nursery bed.
- Tall varieties e.g. kei apple acts as wind breaks.
- Their roots hold soil firmly thus controlling soil erosion.
- Some species e.g. tick berry act as livestock feed.
- Provide shade to livestock.
- When trimmed, they act as a source of organic natter and wood fuel.
- Some species have medicinal value.
- Thorny species are effective in controlling intruders.

Disadvantages of live fences.

- Take many years to grow and make an effective fence.
- Cannot be used for paddocking because they occupy a lot of space.
- Hedges can be hiding places for rodents and thieves.
- Thorny species can cause injury to animals and livestock.
- Requires regular trimming and infilling of gaps which is laborious and expensive.
- Their growth may be irregular thus allowing gaps for thieves and animals to pass through.

DEAD FENCES.

1. **Wire fences.**

- Plain wire fence.
- Barbed wire fence.
- Chicken wire.
- Woven wire.

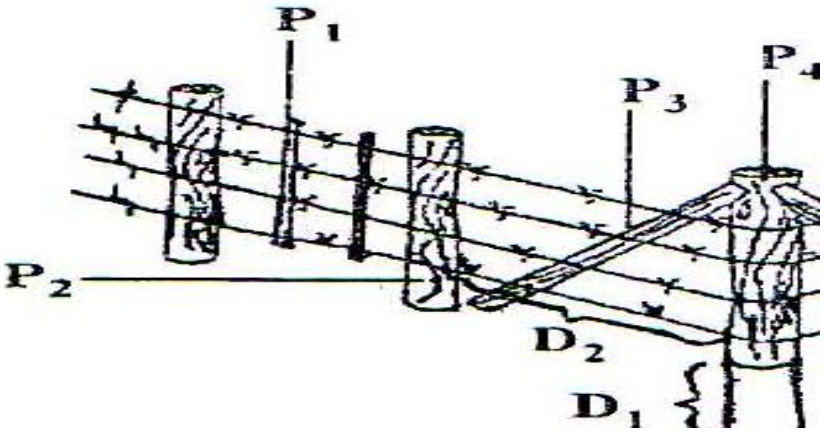
a) Barbed wire.

Distance from one strand to another is 40-50CM and 4-5 lines are required.

Droppers are used to reinforce the barbed wire and are 25CM apart or strainers between 2 intermediate posts in absence of droppers.

Not ideal for sheep because:

- May result to injury to the animal.
- Tears off fleece from the sheep.



b) Plain wire fence.

Made of regular gauge wire without barbs.

Mostly alternated with barbed wire.

Used in docile animals.

Used in partitions other than the perimeter fence.

c) Woven wire fence.

Include chain link and chicken wires.

Chain link makes a very strong fence.

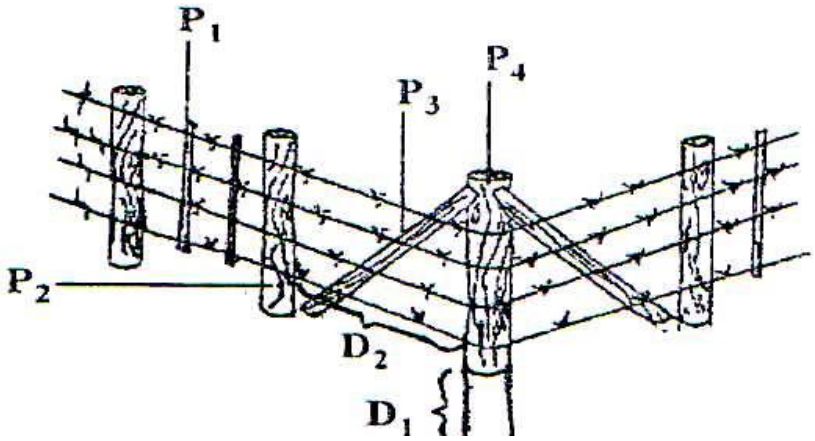
They are held in position by posts and 3-4 strands of plain or barbed wires.

The bottom part of woven wire is buried in the ground 20-30CM to avoid animals and people from lifting it.

PROCEDURE OF ESTABLISHING A FENCE.

- Clear the fence line 2M wide.
- Measure and mark points on the fence line where holes are to be dug determining the position of the gates. Spacing 4-6M.
- Dig holes 60CM deep for the main fence and 75-90CM for corner and gate post.
- Place treated posts in the holes in an upright position.
- Mix concrete 1:3:5 and place in the holes or put soil and stone in the holes and ram to firm the base.
- Nail barbed wires onto the posts with fencing staples while stretching using a wire strainer.
- Fix the lower strand of wire first and use it as a guide to fix the next up to the required number.

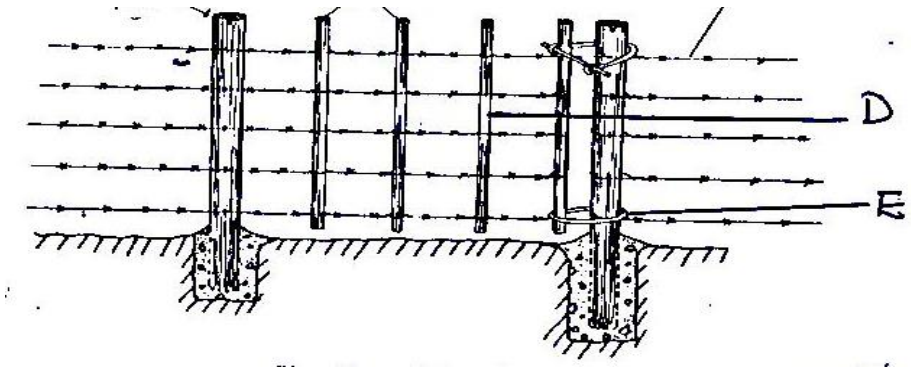
GATES AND CORNER POSTS.



Gates and corner posts should be slightly larger and stronger. Holes should be deeper 75-90CM deep and concrete used to fill the hole after putting the posts.

Allow the concrete to dry before fixing the wire fence.

Braces should be fixed to provide support to the posts and prevent sagging of wire.



2. **Quarry chips, concrete blocks, stones or brick fences.**

Are strong and long lasting but expensive to construct and provide security to the homestead.

3. **Electric fence.**

Mostly temporally constructed for controlling grazing in high quality pastures where strip grazing is practised.

Also used to keep off wild animals in areas where the farm neighbours forest reserves and are a community or government projects as they are expensive.

4. **Wooden fences.**

Cheap to construct. However, they are easily destroyed by termites and moulds.

Should be treated against termites and fungi.

Materials for construction of fences.

- Barbed wire.
- Plain wire.
- Chicken wire.
- Chain link wire.
- Nails and staples.
- Posts and rails.
- Off-cuts.
- Cement, sand and ballast.
- Sticks for use as droppers.

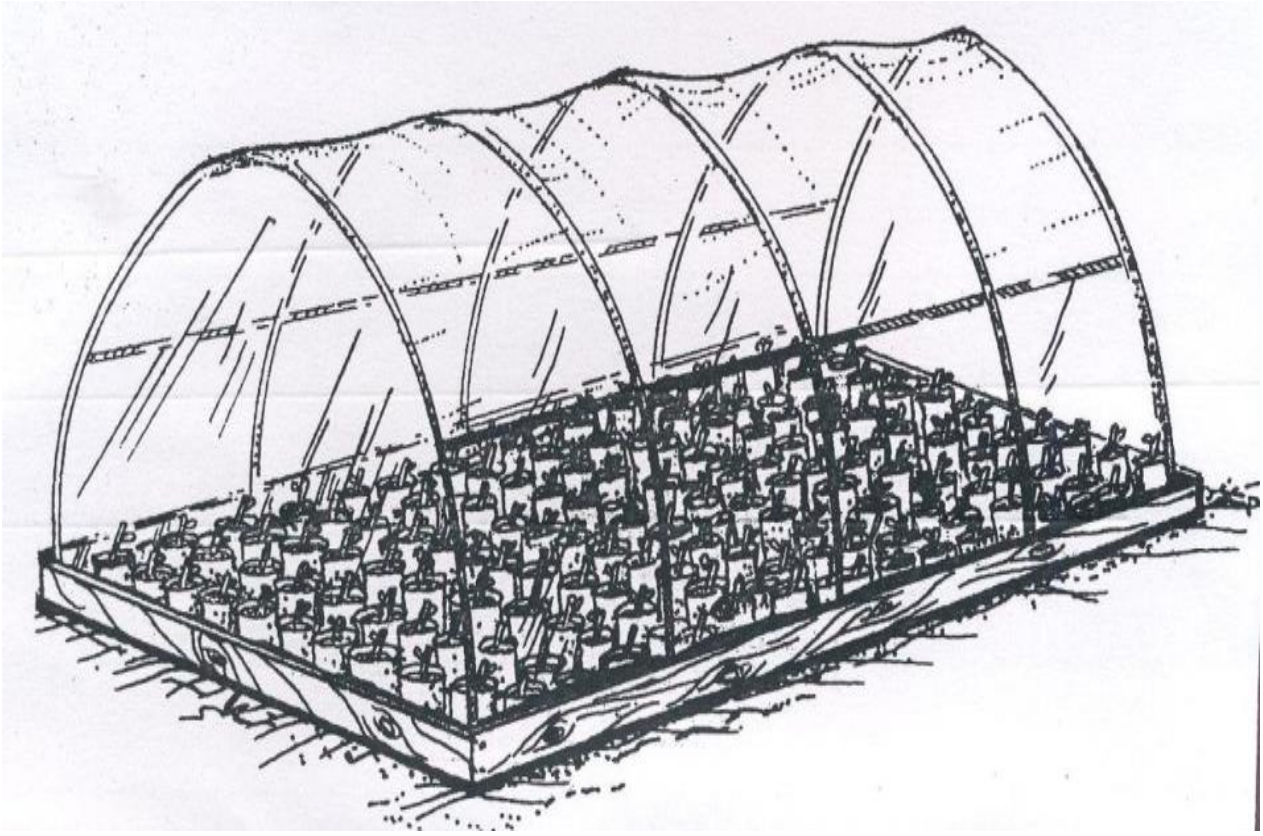
Maintenance of fences.

- Loose or sagging wires should be straightened by use of a wire strainer.
- Broken wires should be spliced.
- Worn out posts should be replaced.
- Broken brace posts and droppers should be replaced.

GREEN HOUSES.

Structures made of glass of translucent walls and roof for growing horticultural crops.

Creates a micro climate effects which facilitate production of certain crops out of season.



Construction materials.

- Metal or wooden frames.
- Translucent materials such as polythene sheets.

Maintenance.

- Broken frames should be repaired or replaced.
- Torn polythene materials should be replaced.
- Dirty polythene sheets should be cleaned.

CROP PRODUCTION STRUCTURES.

- Nursery beds.
- Compost pits/ heaps.

Nursery structures.

Small plot of land used for raising seedlings.

Include:

- Direct nursery bed.
- Seed boxes
- Vegetative propagation unit.

1) Direct Nursery bed.

Temporal shade should be constructed over the nursery bed (1.0-1.2M wide and 0.6M high.)

Helps to reduce light intensity protecting seeds from direct sunlight.

Remove the shade gradually.

2) Seed boxes.

Used for germinating seeds which are then pricked out into the ordinary nursery bed or polythene bags. It is 40CM long 40CM wide X 10 CM deep.

Seed boxes are then placed under a shade or green house

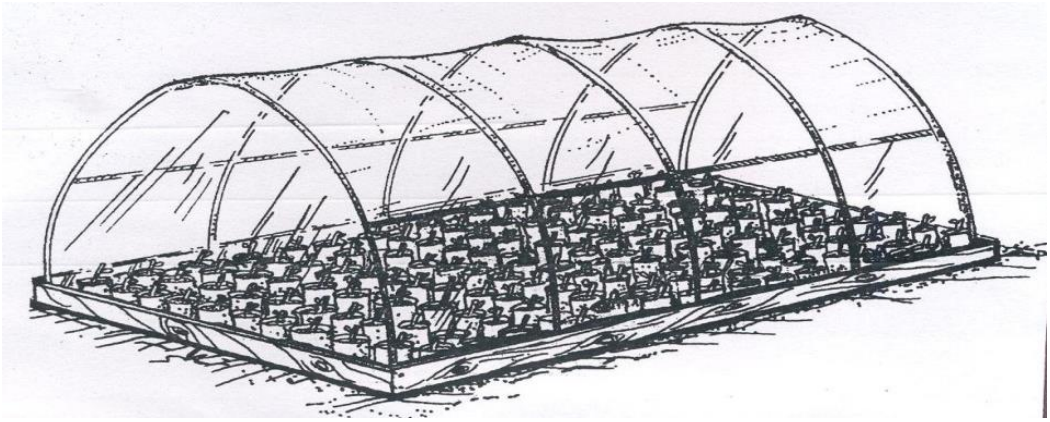
3) Vegetative propagation unit.

Used for raising vegetative propagation materials e.g. coffee, tea, citrus and fruit trees.

3.66M X1.22M (holds 1200 sleeves).

Sleeves are filled with rooting mixture (sub soil, DSP and sulphate of Potash)

Sleeves are then arranged in the unit.



Factors to consider in siting a Nursery structure.

1. **Source of water.**

Near a reliable source for adequate watering of seedlings.

2. **Soil type.**

Fertile and well drained.

3. **Sunshine.**

Should receive enough sunshine thus located away from tall trees. Roots of trees may also interfere with seedling growth.

4. **Security.**

Well fenced to guard against thieves and livestock.

5. **Location in relation to filed where crops are finally established.**

Should be near the seedbed to save on time and labour during transplanting.

Construction materials for nursery beds.

- Timber posts and off cuts.
- Forked sticks.
- Polythene sheets, glass or translucent sheets.
- Bamboo splits.
- Thatch or woven thatch materials.
- Nails, laches and hinges.

Maintenance.

- Repair and replace broken parts.
- Replace worn out polythene sheet and thatch.

COMPOST HEAPS.

Structures for decomposing plant materials.

Built on flat ground and materials heaped on top of each other in layers.

Are 1.2M high 1.5M wide and 1.5M long.

CHAPTER FOUR.

AGRICULTURAL ECONOMICS II.

(LAND TENURE AND LAND REFORM.)

Land tenure.

- Describe the possession of right to the use of land.
- Or rules and conditions governing the ownership of land in a specific area.
- Or method by which an individual or group of people acquire rights to use land in any place.

Categories of tenure systems.

There are two main categories.

- Collective tenure system.
- Individual tenure system.

Collective land tenure system.

- Communal tenure system.
- Co-operative tenure system.
- State ownership.

a) Communal tenure system.

Allows (traditionally) the possession of land by the whole community or a section of the community.

Individual members have equal rights to the use of land.

Everyone uses the land as they wish.

Advantages of communal land tenure system.

1. The problem of landlessness does not exist.
2. Land cannot easily be fragmented.
3. Allows free movement of livestock.
4. Land is left to rest for a while to allow pasture regeneration.
5. Elders of the community solve any local problems thus there are no land disputes.

Disadvantages of communal land tenure system.

1. As land belong to everybody, no individual has the responsibility of taking care of the land or developing it.
2. Farmers have no incentive to manage and develop the land because it can be taken away from them at any time.
3. Poor yields as people try to exploit the land large herds of livestock are kept resulting to overcrowding and poor animal yield.
4. Poor stock breeding programme. Livestock keepers have no incentive to improve the quality of animals as they mix with others leading to random mating and uncontrolled breeding.
5. Parasite and disease control. This is difficult due to mixing of animals.
6. Farmers have no title deed which can be used as security to obtain bank loans for developing the land.
7. Soil erosion and land denudation due to short term maximising of land, land occupants overstock the land leading to overgrazing which leads to soil erosion.

b) Co-operative land tenure system.

Land is owned by a group of people on co-operative basis. A group of farmers come together to form a co-operative society and title deed is issued in the name of the co-operative.

Advantages of co-operative system.

1. Since nobody can legally claim individual ownership of land there are no land disputes.
2. Labour is well utilised.
3. Profit from the land is distributed according to the number of shares an individual has in the society.
4. Large membership increases the resources thus enhancing effective farm mechanisation.

Disadvantages of co-operative system.

1) Poor management and embezzlement of funds leads to inefficiency in the system.
2) Individuals cannot use the land title to obtain loans because the title deed is in the name of the society.

c) State ownership.

Land is owned by the whole state and is referred to as government land.

The state controls the use of land. E.g. ADC farms and Ujamaa villages in Tanzania.

Advantages.

1) Generates income to the state which is equally distributed to the citizens.
2) May open up more employment opportunities to citizens and give refuge to squatters.

Disadvantages.

1) Operates in a non-competitive market which may results in low quality production.
2) Workers involved do not have as much motivation as for individual ownership.

INDIVIDUAL TENURE SYSTEM.

Land is owned by an individual who either operates or leaves it to another person.

Includes:

- Individual owner operator.
- Landlordism.
- Concession/company.

The individual owner operator.

Farmer owns and operates the land.

Advantages of individual operator.

1) Provides the greatest incentive in farming, conservation and improvement of land.
2) Where the farmer has a title deed, it acts as security to obtain agricultural credits/loans.
3) Owner has incentive for long term investment in the land.
4) The owner can sell or give away the whole or part of the land.

Disadvantages of individual operator.

1) There is increase in government cost especially extension services.
2) In case the farmer uses title deed as security to obtain a loan which is not repaid, the land is sold.
3) Encourages land fragmentation.
4) May encourage inequality in land ownership hence poor resource distribution.

Landlordism and tenancy.

The landlord transfer the right to use of land to the tenant at a payment.

Agreement may be formal or informal.

Where the agreement is formal, both the tenant and landlord know their obligations and tenant has a legal backing.

Leasehold land tenure system.

Form of landlordism where the state gives legal rights to individuals to own and use land for a specified period of time.

If the lease period is long and rent rates fixed, economic performance may be quite good.

Advantages of landlordism and tenancy.

1) Landlords who cannot use their land get income after renting to tenants.
2) Land that would otherwise be idle is put into agricultural use by tenants thus increasing production.
3) Landless can rent land from the landlords to earn a livelihood.
4) Reduces disputes since the landlord or the state controls its allocation.
5) Ensures equitable distribution of land as a natural resource.

Disadvantages of landlordism and tenancy.

1) If tenants have no written agreement, they will have no incentive on the land.
2) Where lease period is short, the tenants may have no incentive to make long term investments.
3) Land rates are not fixed by the government which may lead to overexploitation of tenants.
4) Where lease periods are short, the main consideration is profit maximisation and the tenant is not concerned about land improvement.

Concession/company.

Concession. Agreement between the company and the government on the use of land for a specified period of time.

Also called **estates/plantations.** Involves large scale production of one commodity only.

Advantages.

1) Achieves good economic results due to high efficiency in land use and management.
2) Benefits the country by creating employment to the citizens and paying taxes to the government.

Disadvantages.

1) The companies may engage in monopolistic practices.
2) If management is inefficient, huge losses may be incurred.
3) Where ownership is wholly foreign, benefits to the country are limited to job creation and paying taxes to the government.
4) They are liable to labour and social problems which could adversely affect its economic performance.

FRAGMENTATION AND SUB-DIVISION OF LAND.

Fragmentation.

Situation where a single farmer owns several parcels of land scattered over a wide area.

CAUSES OF LAND FRAGMENTATION AND SUB-DIVISION OF LAND.

1) **Shifting cultivation.**

In most cases the first person to clear and open up the piece of land is assumed owner. In the long run, one individual ends up owning several but scattered pieces of land. Due to population pressure such movement is no longer possible. Thus the farmer end up with fragmented land.

2) **The traditional system.**

This is where each heir is entitled to an equal share of inheritance. The farmer is forced to sub divide land to the family in equal shares.

3) **Population pressure on a limited area of land.**

A famer may be forced to buy several pieces of land in different places as a result of population pressure on the limited amount of land.

4) **Accumulation of land holdings.**

By money lenders as a results of debtors failing to pay.

5) **Method of settling debts in the traditional society.**

Whoever may have been owned such debts ended up owning several pieces of land.

LAND SUB-DIVISION.

It is the partitioning of a piece of land into small portions.

When an individual wants to subdivide land, an application is made to the Land Control Board stating the sizes of portions into which land has to be sub-divided.

Once consent is obtained then a land surveyor will survey the land and subdivide it accordingly, giving the portions new registration numbers.

The survey department then takes the new numbers to the land registry to register them in the new owner's names and issue new certificates which cancel the old ones.

Inheritance is the acquisition of land by children from their parents or older relative.

For one to inherit a registered land upon the death of a relative one is expected to fill the **"transmission/notification and death form"** a death certificate will be required during the application for certificate of succession form. The name or names of people who intend to inherit the land are stated in this form. All these documents are forwarded to the magistrate's court. The court will then summon the person or persons concerned to determine who should inherit the land. The magistrate, having determined the inheritance will inform the land registry which then register the new owner(s) and cross out the name of the previous owner.

THE EFFECT OF FRAGMENTATION AND SUB-DIVISION OF LAND.

1) Time is wasted while travelling from one holding to another or from the farmstead to the various fragment.
2) Proper and effective control of weeds and pests become difficult since the fragments are surrounded by other farmer's holdings. The other holdings may have been neglected so they become sources of infestation.
3) Difficulties of following a sound farm plan arising from the distance between fragments and the farmer's home.
4) Difficulties in the supervision of the scattered plots.
5) Control of livestock parasites and diseases is difficult as they are transmitted as animals move from one filed to another.
6) Difficulties in carrying out various soil conservation measures without the co-operation and concerted efforts from all the farmers. Such soil conservation devices may also take unduly large portions of the fragments.
7) The size and shape of such holdings may be such that it is virtually impossible for the farmer to restrict grazing in one holding only. It could turn out to be a kind of communal grazing.
8) Difficulties of offering extension advice. Thus it becomes difficult to help the farmer to increase farm productivity.

LAND REFORM.

Any organised action designed to improve the structure of land tenure and land use.

Or integrated programmes to bring about more effective control and use of land.

Aims at altering the system or rights to the use of farming land in such as way as to achieve the most effective utilisation of agricultural resources.

Include.

- Land tenure reform.
- Land consolidation.
- Land adjudication and registration.
- Settlement and resettlement.

LAND TENURE REFORM.

Programmes aimed at altering the land tenure legislation so as to enhance effective utilisation of land.

Important objectives of land tenure reform.

1) To encourage conservation measures on the land and general improvement of the land.
2) To achieve increasing productivity of both land and labour.
3) To encourage commercial instead of subsistence production in order to ensure meaningful employment in rural areas.
4) To encourage farmers to invest more through offering security of tenure.
5) To achieve flexibility in farming patterns to meet changing national and market demands.
6) To achieve effective utilisation of national land resources, including settlement of unused land and introduction of irrigation schemes where applicable.

Examples of land tenure reform.

- The improvement of land tenure legislation.
- The consolidation of fragmented holdings.
- The tenancy reforms.
- The redistribution of land.
- Formal registration of individual land titles.

LAND CONSOLIDATION.

This is bringing together fragmented pieces of land under one holding for better and more effective utilisation.

Involves establishment of ownership, measurement, description and recording of each fragment.

Individual fragments are then consolidated (put together) into one holding, around the most developed or biggest parcel.

Development measures such as creation of villages, farm planning, construction of access roads and access to water are undertaken in the process.

Advantages of land consolidation.

1) Proper supervision of land.
2) Economic use of time and saving on transport cost.
3) Agricultural advice by the extension officers is possible.
4) Sound farm planning and adoption of crop rotation programmes.
5) Soil conservation and land improvement. Facilitates carrying out of soil conservation practices as well as farm mechanisation since the holdings are enlarged.
6) Construction of permanent structures such as fencing and buildings is possible.

7) Economic operation of activities on the land is possible since it gives the farmer a large single unit of land.
8) If the land is already registered, it gives the farmer legal ownership and the title deed which can be used to obtain loans.
9) Weed, pest and disease control is enhanced.

LAND ADJUDICATION AND REGISTRATION.

Land adjudication involves the establishment of ownership, measurement, description and recording of land.

The government sends its adjudication officials who liaise with the chiefs and local farmers to establish concretely the ownership of land within a specified are.

At the end of the whole process a land certificate or title deed is issued to each farmer whose land has been adjudicated as evidence of legal ownership.

Information contained in the land register and the title deed.

1) The number of the title, which is the same as land parcel number or location.
2) Size of land.
3) The name and identity number of the owner.
4) Type of ownership e.g. absolute. Leasehold or freehold.
5) Conditions of ownership if any.
6) Seal and signature of the issuing officer.
7) Date of registration.

Advantages of holding a land title deed.

1) It can be used to secure credit facilities necessary for land development, hence encouraging commercial farming.
2) Since the registration confers security of tenure, any land disputes are minimised.
3) Tenure security encourages farmers to invest in long term and permanent projects and care for the soil.
4) Enables the occupant to lease all the land nor part of it thus get extra income.

SETTLEMENT AND RESETTLEMENT.

Settlement.

Occupation of land which was previously uninhabited. Or planned and controlled transfer of population from one area to another which is uninhabited or sparsely habited.

Resettlement.

Process of transferring people from densely populated areas to sparsely populated areas.

Objectives of land redistribution.

1) To ease population pressure from over-populated areas.
2) To increase agricultural production by making better use of uninhabited or idle land.
3) To create employment. By increasing agricultural production people become self-employed.
4) To form some kind of tstetste fly consolidated barrier e.g. in lambwe valley in Kenya.

Development of settlement schemes in Kenya.

European settlement.

The government enacted two land ordinances in 1903 and 1911 to provide for the “alienation of the land” for European settlers. Most settlers were farming for the export market because there was plenty of land, cheap labour and a small local market for agriculture products.

African settlement.

Resettlement schemes were mainly concerned with population relief.

Early settlement.

This was the first phase of African settlement programme, before independence.

At first communal settlements were tried but later failed due to lack of co-operative spirit among farmers.

These settlement did not satisfy the hunger for land by Africans which lead to the “million acre scheme”.

Later settlement.

Second phase of African settlement programme. The main aim was to transfer most of the land in Kenyan highlands formerly occupied by the whites to the Africans.

The million acre scheme.

The aim was to transfer one million acres of land in the "white highlands" to Africans by the time independence was achieved.

The "million Acre scheme" was dived into the following categories:

a) **High Density schemes.**

These were high density areas where land was fertile and productive and could be farmed intensively. Average land size was 11 hectares.

b) **Low density schemes.**

Found in areas where land was relatively poor, population was low and farmers had larger holdings. Average land size was 15 hectares per person. More successful in terms of development and loan repayment and production than the high density schemes.

General objectives of the Million Acre scheme.

1) To transfer land from the white settlers to the Africans.
2) To reduce population pressure in the African reserves.
3) To settle former employees of European farmers and squatters.
4) To solve the unemployment problems.
5) To increase agricultural production, through better methods of land utilisation.
6) To maintain production levels achieved by former white settlers and also earn foreign exchange from the sale of cash crops.

Examples of settlements under this scheme.

1) **Ol Kalou salient scheme.**

Was an experiment aimed at co-operative large scale farming. Each member was allocated one hectare for subsistence and to build a house on.

Some of the land was bought by the Kenyan government and distributed to African farmers.

2) **Harambee settlement schemes.**

The average land size was 15 hectares per person. Concentrated on growing maize and rearing of cattle. No development loans was given.

3) **"Z" plots.**

Were 100-acre plots surrounding the houses formerly owned by white settlers. Sold to wealthy Africans at high cost because they had improved permanent structures such as milking parlours, dips, fences, water and lighting systems.

Other settlement schemes.

1) **Jet schemes.**

Curved out from the national forests before independence and were administered by the provincial administration. For credit and issue of land certificates.

2) **Haraka schemes.**

Made out of abandoned and mismanaged farms administered by the Central Land Board. Squatters on theses farms were registered, and given plots upon payment of a small fee.

3) **Shirika schemes.**

Were meant to buy the European settlers' farms in the high potential areas and settle the landless. Managed by competent managers on behalf of the co-operatives and the government. Settlers' were given 2 hectares for subsistence and had to provide all the labour.

4) **Lari settlement scheme.**

Found in kiambu district. Was a high density scheme based on mixed farming.

Requirements for the success of settlement schemes.

1) There should be high population pressure in the reserves.
2) There should be adequate economic incentive.
3) The social cost of moving from home community and the discipline imposed for sound agriculture and extra effort.
4) Setters should come from far distances from the schemes in order to be able to break from traditional society and stay on the scheme.
5) Settlers should have enough capital.

CHAPTER FIVE.

SOIL AND WATER CONSERVATION.

Soil and water conservation involves all the practices carried out to prevent removal of soil from land and protect water sources and maintain supply.

SOIL EROSION.

Process by which soil is detached, removed and carried away from one place to another where it may not be useful.

Natural erosion is a normal geological process.

FACTORS INFLUENCING SOIL EROSION.

1) **Amount and intensity of rainfall.**

Excess rainfall carries soil away. Rain drops hit the ground with force that splash up soil away.

2) **Slope of land (Topography)**

Speed of runoff is determined by the slope of the land. The greater the speed of water the greater the erosive force.

3) **The type of soil.**

Ability of water to infiltrate into the soil depends on the soil type. Sandy soils with coarse texture becomes saturated faster hence easily eroded.

4) **Soil depth.**

Shallow soils becomes saturated with water quickly thus are easily eroded.

5) **Vegetation cover.**

Forest protect soil against erosion by preventing direct exposure of soils to agents of soil erosion. The tree canopy reduces the impact of raindrops.

6) **Overstocking.**

Leads to overgrazing leaving soil surfaces bare hence soils are exposed and become loose.

Trampling of land by animals has an erosive effect on the soil.

7) **Deforestation.**

Indiscriminate removal of trees from forested areas.

Soils will be exposed to high temperatures and heavy rainfall.

8) **Planting of annual crops on steep slopes.**

Leads to frequent cultivation hence exposure of soil to erosion.

9) **Indiscriminate burning of vegetation before cultivation.**

This destroys the soil structure leaving soil loose and exposed to agents of soil erosion.

10) **Clean weeding.**

Leaves soil unprotected against water erosion.

11) **Plough up and down the slope/across the contours.**

TYPES OF SOIL EROSION.

Soil erosion by water.

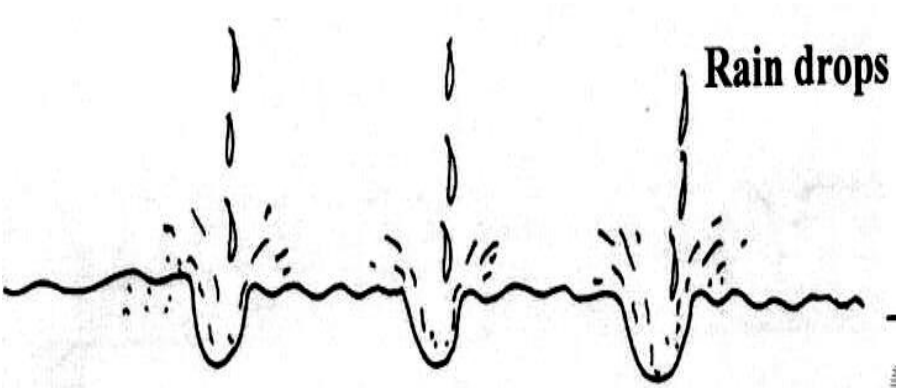
Splash/raindrop erosion.

Soil splash resulting from the impact of water drops directly on soil particles.

Has greater impacts in bare soils. Kinetic energy of water dispersers the soil particles by detaching and transferring them in splashes.

Could results to carrying away of seeds planted shallowly.

Raindrop impact on bare soils decreases aggregate of soil particles leading to destruction of soil structure.

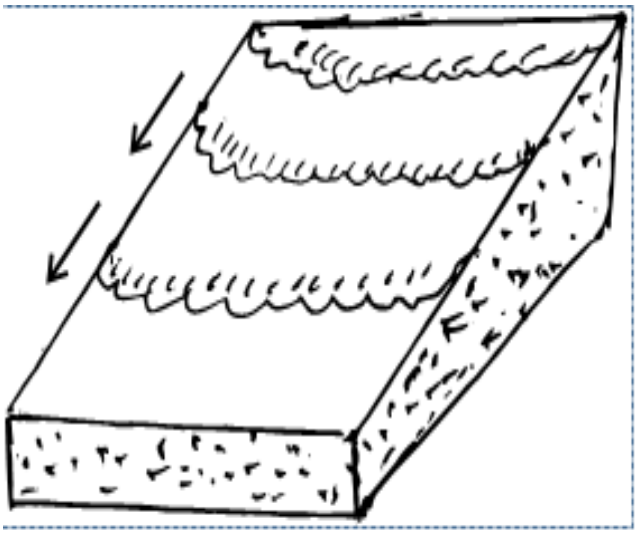


Sheet erosion.

Uniform removal of soil in thin layers from flat or gently sloping land.

Areas with loose, shallow top soil overlying a light sub soil are more susceptible.

The eroding power of water in the sheet flow depends on the amount and speed of surface run off.

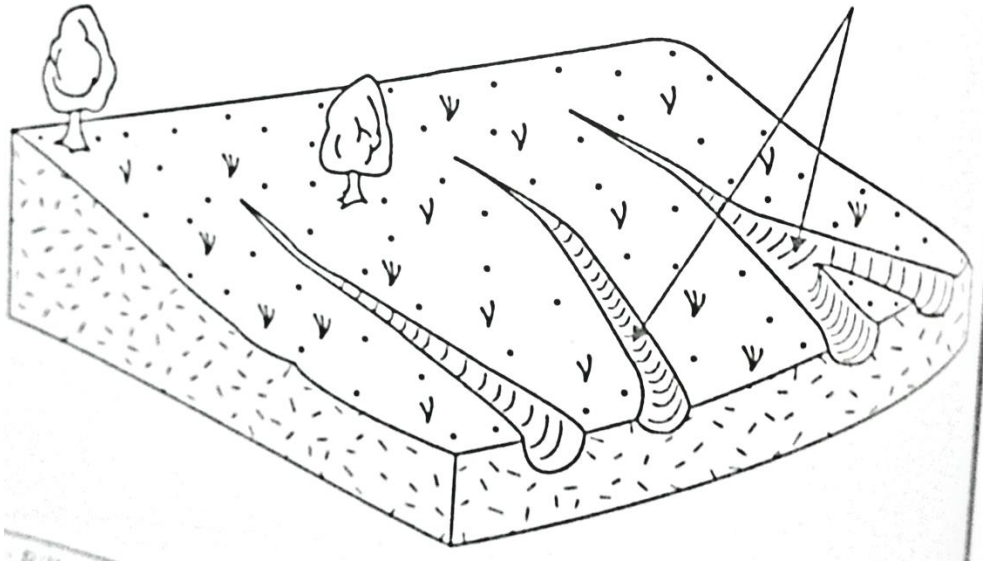


Rill erosion.

Removal of soil by water from small but well defined channel (rills) or streamlets where there is a concentration of flowing water down the slope.

Occurs on slope with little vegetation or in ploughed fields.

Small enough to be filled easily by normal tillage operations.



Gully erosion.

Advanced stage of rill erosion.

Small channels get progressively deeper and wider. Characterised by deep long ditches made by running water,

Process in gully formation.

- Movement of water from water-shade.
- Channel erosion caused by flowing water.
- Wearing of the sides of the channel.
- Scouring of the floor of the channel by moving water.

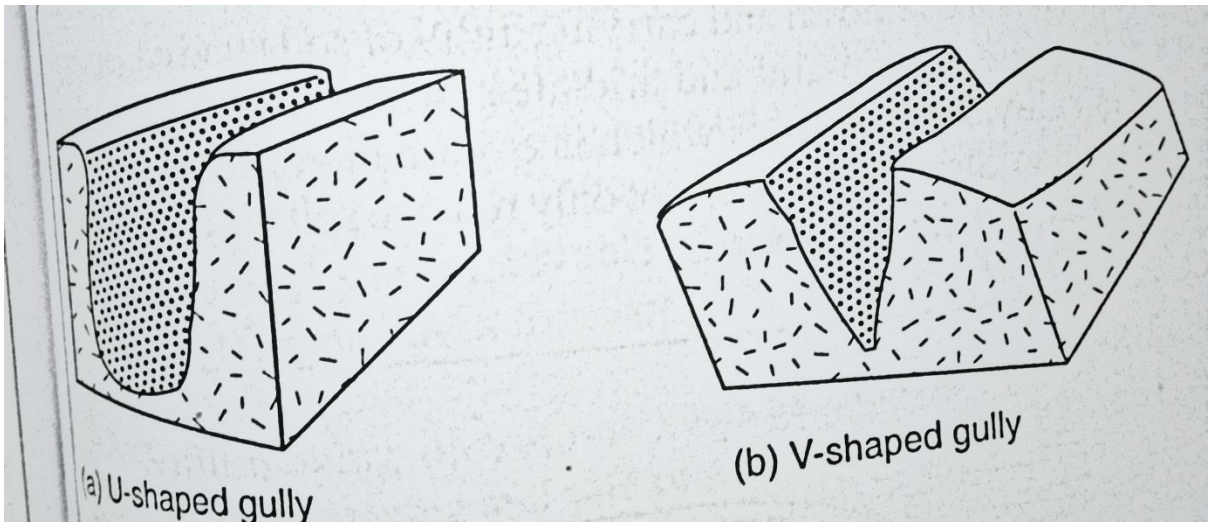
Types of gullies.

V-shaped gully.

Formed as a result of scouring of soil by concentrated run off in areas where soil is deep and there are unprotected depressions.

U-shaped gully.

Occurs where there are resistant materials on gully floor.



Soil erosion by wind.

Removal and carrying away of soil by wind.

Severe in semi-arid areas where land is bare and cultivated land where soil is bare and exposed to sun.

Takes place by:

- Suspension of light soil in the air.
- Bouncing along the surface.
- Creeping over the land surface.

Soil erosion through mans' activities.

- Overstocking and overgrazing in ASALS.
- Indiscriminate clearing of forest and other vegetation.
- Earth moving operations e.g. mining, road and building construction, quarrying and sale of sand contribute to soil erosion.

EFFECTS OF SOIL EROSION.

1) The eroded productive soil is lost forever. The top soil contains organic matter and plant nutrients hence lowering productivity of land.
2) Soil micro-organisms are also carried away. Some break up soil organic matter to humus. Eroded soils have poor soil structure that does not support healthy crop growth.
3) Deposition of eroded materials in dams and rivers makes them shallow by creating siltation problems.
4) Sedimentation and silting in water bodies lead to decline in fish production.
5) Excessive surface run-off causes damages by exposing underground water pipes and destroying roads.

River bank erosion.

Occurs along the river banks as a result of large volume of water and amount of materials carried by water.

Effects of riverbank erosion.

1) Materials carried by water damage the banks depending on volume and speed of water.
2) Widens the river bed reducing the potential size of cultivable land.
3) Leads to sedimentation in dams and other water bodies.

Control measures.

1) Construction of dams to regulate the flow of water.
2) Construction of dykes e.g. River Nzoia to control flooding of Budalangi plains.
3) Planting trees along the river banks to hold soil together.
4) Observing government regulation on leaving a sizeable strip of uncultivated land along the river bank.

Solifluction erosion.

Solifluction. Gravitational flow of surface materials saturated with water.

The earth flows from steep slope due to heavy rainfall.

Solifluction is a form of mass wasting.

Mass wasting. Downward movement of weathered material on a slope under the influence of gravity.

Factors influencing mass wasting/ Solifluction.

1) **Slope of land.**

In steep slope movement of the materials is fast compared to gentle lying plains.

2) **The nature of material.**

Materials containing a lot of water move easily downslope.

If large rocks overlie weak sedimentary rocks which have clay or shale materials underneath, mass wasting occurs easily.

3) **Climate.**

Areas with high rainfall have wet materials which are easily moved under the effect of gravity.

4) **Vegetation.**

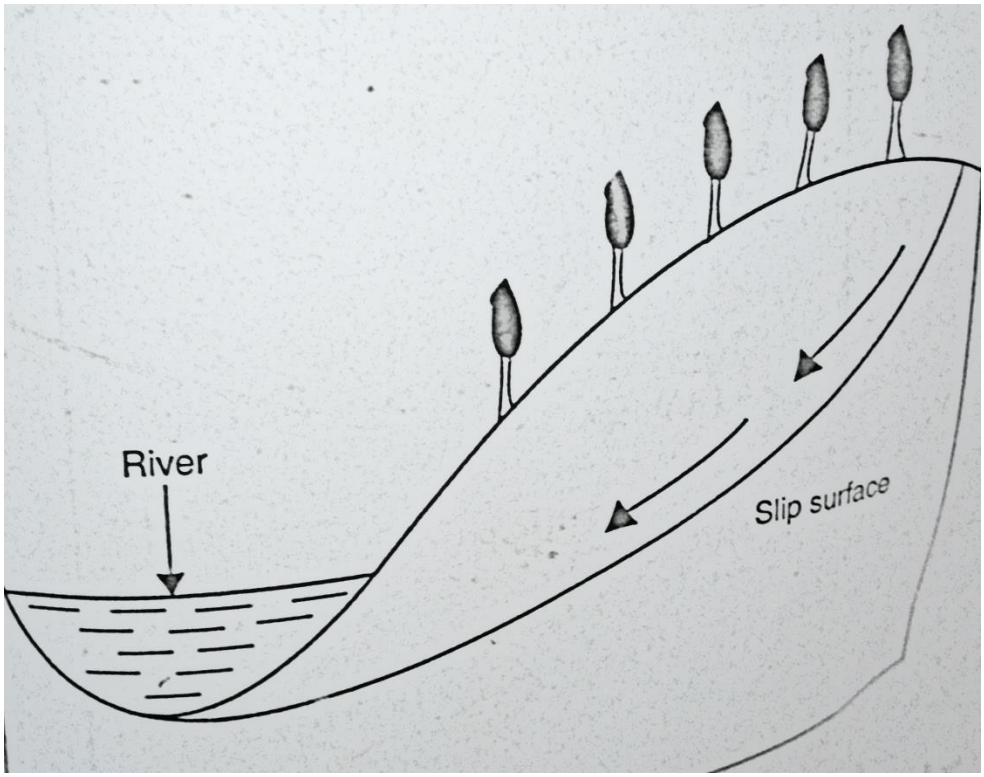
Bare soils are easily carried away downslope.

5) **Human activities.**

Deforestation, building, quarrying and cultivation interferes with stability of surface layers thus initiating mass wasting.

6) **Forces within the earth's crust.**

E.g. earth tremors and volcanic eruptions cause large and widespread movement of materials.



Landslides.

Landslide. Sudden rotational movement of a mass of soil or rock along a more or less semi-circular slip surface.

Water content of materials is minimal compared to Solifluction.

Types of landslides.

Slump/slip.

Intermittent movement of earth or rock masses for a short distance involving backward rotation.

May lead to reverse slope.

Independent units of slip leads to numerous step-like terracets.

Slumping can be initiated by undercutting of a slope by a steam, waves or human activities.

Debris slide/earth slide/soil slip.

Materials move at great speed and may lead to loss of life and property.

Debris fall.

Movement of materials along vertical or overlying cliff. It is a sudden movement.

Rock fall.

Occurs on very steep and nearly vertical slopes where blocks of rocks move down a stiff cliff.

Common in steep slopes and in wet seasons.

Rock slides.

Masses of rock materials that slide down along a bedding plane, a joint or a fault line.

EFFECTS OF MASS WASTING AND SOLIFLUCTION.

1. **Soil fertility.**

Materials derived from fertile origins ends up in different destinations leading to fertile soils in regions where they are deposited.

2. **Creation of lakes.**

Debris/blocks of rocks block river courses creating temporal lakes.

3. **Damaging property and causing loss of life.**

Destroys buildings, homes, infrastructural networks and leads to loss of lives.

4. **Soil erosion.**

Facilitates soil erosion in steep slopes.

5. **Permanent scars on the landscape.**

These areas remain unattractive to settlement since they are bare and cannot support vegetation.

6. **Tourist attraction.**

Rock fall are tourist attraction e.g. the weeping stone of Kakamega and kit mikai in seme.

METHODS OF SOIL AND WATER CONSERVATION.

- Biological/cultural control.
- Physical/structural control.

BIOLOGICAL/CULTURAL CONTROL MEASURE.

1. **Grass strips/filter strips.**

Uncultivated strips 1-2 metres wide along the contour between cultivated strips (30M).

The strips are composed of grass and they gradually form terraces.

Importance.

- Reduce speed of run off and filter out soil.

Limitations.

- Limit machine use.
- Harbour pest increasing pest infestation to the crops.

2. **Cover cropping.**

Involves establishment of crops that spread over the surface of the soil to provider a cover. Such crops include Desmodium, sweet potatoes etc.

Importance.

- Decreases raindrop impact.
- Prevent soil from being baked by the sun thus preserving soil moisture and volatile soil nutrients.
- Reduces the speed of runoff and increases water infiltration into the soil.

3. **Contour farming.**

Tillage and planting are done across the hill to create ridges of earth which hold up water and prevent rill erosion by reducing water run- off. It checks erosion on gentle slopes.

Includes: contour ridging and contour planting.

4. **Mulching.**

Role of mulching in soil and water conservation.

- Prevents splash erosion.

- Reduces speed of run-off and thus increases water infiltration.
- Reduces evaporation.
- Increases organic matter and water retention capacity.

5. **Cropping systems.**

- **Rotational grazing.** In ASALS to allow grass time to recover after each period of grazing.
- **Crop rotation.** A grass-legume should be included to maintain soil structure.
- Timely planting, correct spacing of crops and application of manure.
- **Intercropping.** Soil conservation measure. Crops with inadequate ground cover should be intercropped with crops with a good ground cover such as legumes.

6. **Strip cropping.**

Crops with little soil cover are grown in alternate strips with those having good ground cover.

The different strips control movement of soil particles hence controlling soil erosion.

7. **Grassed/vegetated waterways.**

Continuous depression man-made or natural through which water flows.

Grass/vegetation is planted in the depressions to slow the speed of water and traps eroded soil preventing further erosion.

Should not be used as a track or grazing place.

8. **Afforestation and reaforestation.**

- **Afforestation.** Planting of trees where they never existed.
- **Reaforestation.** Planting trees where forests have been cleared.

Roles of tree in soil and water conservation.

1. Protect the soil below from raindrop erosion by reducing the force with which it falls onto the ground.
2. Provide shade and reduce loss of moisture through evaporation.
3. Acts as windbreaks.
4. The roots of trees bind soil particles together.
5. Reduces speed of running water thus reducing its erosive power.
6. The leaves decay to supply humus which improves soil structure and increases water infiltration into the soil.

7. **Agroforestry.**

Trees in this system helps in reducing soil erosion among other benefits..

PHYSICAL/STRUCTURAL CONTROL MEASURES.

Involves mechanical constructions.

Helps to drain or infiltrate the excess water and to retain the required moisture content in the soil.

1. **Trash line/ stone line.**

Trash made of crop residues or stones are heaped along the contour.

Helps to trap soil being carried away.

2. **Bunds.**

Heaps of soil along the contour.

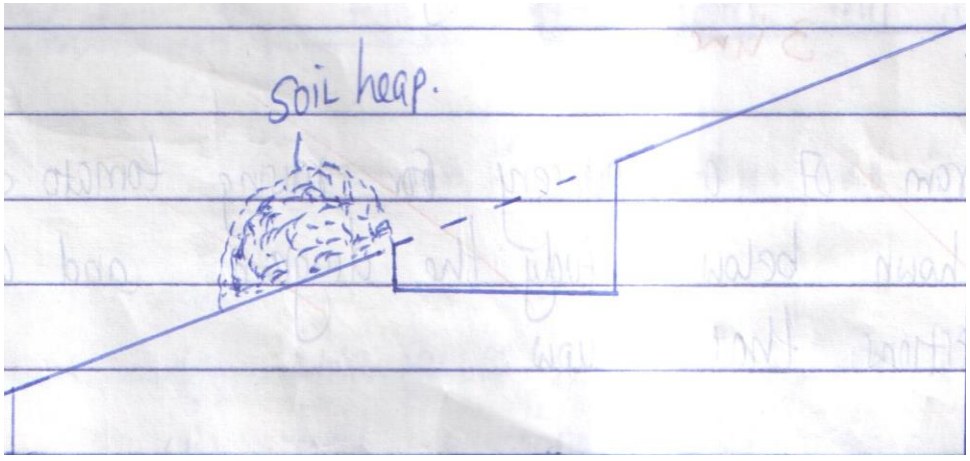
Grass may be planted on top of the bund to hold the soil together.

The banks of earth are 1-2M wide at the base and 60CM high.

Built on contour with short-ties every 5-10M to channel above the bund.

Suitable for fairly small cultivated areas on moderate slopes.

Should not be more than 30CM apart.



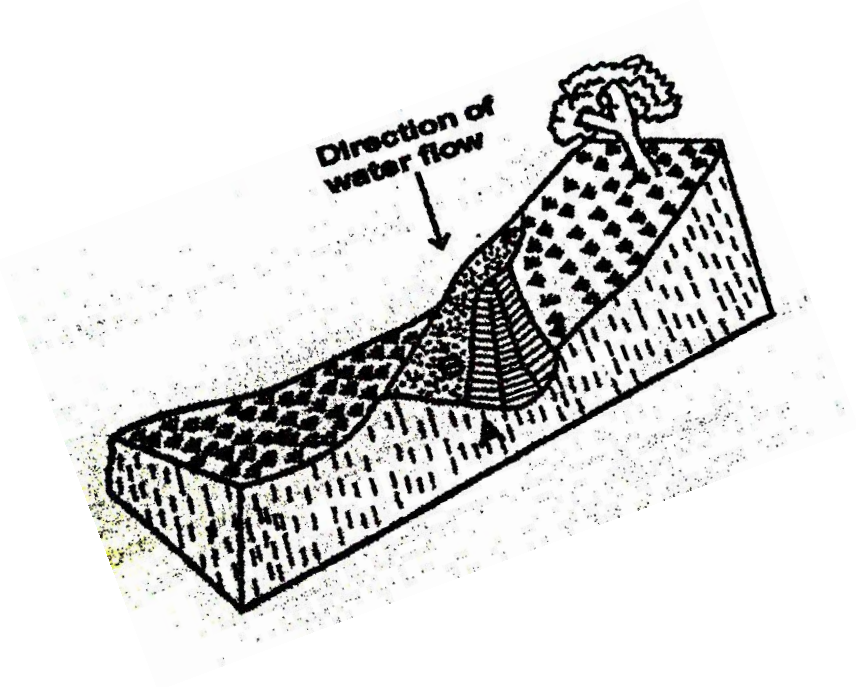
3. **Cut-off drains/diversion ditches.**

Open trench with an embankment on the lower side.

Large quantities of water e.g. fro, road ditches and overgrazed hills emptying water into cultivated land cannot be stopped by terraces and grass strips and have to be diverted to areas where soil erosion cannot occur.

Should have an embankment on lowers side of the channel which holds any excess water that may overflow.

Embankment should be stabilised by grass or trees.



Cut-off drain discharges its water to.

- Natural waterway such as a river.
- Unto a non-erodable stony or rock ground.
- Onto grassland with well-established grass cover.
- Into an artificial waterway.

4. **Terraces.**

Constructed to reduce the surface flow of water and to carry away excess water that cannot be absorbed by soil.

Done where slope is between 13-55%.

Types of terraces.

a) **Broad-based terraces.**

Wide at the base (3M or more) and 2/3M high at the crest.

Have a shallow drain (channel) on top.

250M long and heavy machinery are needed to level the terrace thus expensive.

b) Narrow –based terraces.

Level and shorter and closer than broad-based terraces.

Constructed manually. Are planted with grass or long term crops. Built along the contour or on slight gradient with channels on upper and lower sides.

Suitable on 12-20% slope.

c) Bench terraces.

Constructed on steeper slope (35-55%).

Justified when:

- Growing of high value crops.
- Where there is an acute shortage of suitable land.

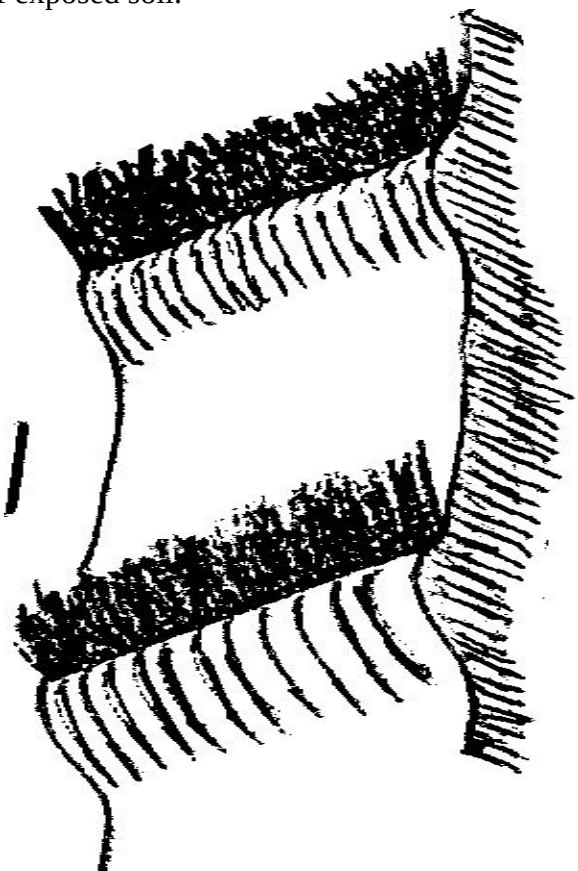
The top surface layer is kept aside and spread on top after construction.

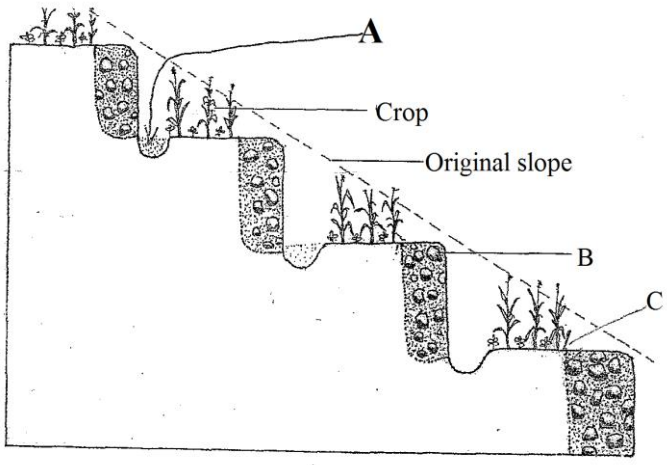
At the top, there is an embankment planted with grass.

Top bank is protected by stone wall or grass and is built as vertically as possible.

Limitations.

The banks and upper parts may harbour weeds so the cultivated area usually become unproductive because of exposed soil.





May develop from vegetative strips of "fanya juu" terraces or by excavating deep soil for arable farming. The land is reshaped into a series of steps.

d) "Fanya juu" terraces.

A ridge made by digging a channel (60cm wide and 60-90cm deep) and throwing the soil uphill.

Grass should be planted on the ridge to protect it.

Suitable in arid areas where grass strips without ridges are unreliable especially in steep slopes and where grass may be eaten by termites during the dry spell.

After some time, they develop into bench terraces.

5. **Gabions/porous dams.**

Boxes of galvanised wire mesh filled with stones which are built across slopes and gullies.

May be prefabricated or made on site.

Trap soil as it flows through the stones and reduce the erosive force of run-off by reducing its speed. The soil then fill up the gull.

6. **Dams and reservoirs.**

- **Dam.** Wall or barrier built across a river or waterway to hold and store water. It also reduces the speed of water.
- **Reservoirs. (Tanks.)** Holds excess water from roof tops.
- **Check dam.** Constructed across a channel or a gulley. Reduces the speed of water and allows soil to settle. Made of plant debris, concrete or stone.

WATER HARVESTING.

Any watershed manipulation carried out to decrease surface run-off.

METHODS OF WATER HARVESTING.

1) **Using weirs and dams.**

a) **Weirs.**

Barrier constructed across the river to raise water level and still allow water to flow over it.

Used to facilitate pumping of water or flow by gravity.

b) Dams.

Barrier constructed across a river or a dry valley to collect and hold large volume of water. Raise the water and forms a reservoir or lake for storing water.

Should have a spillway to allow excess water to flow away.

Bottom part should have an impervious layer to prevent water seepage. Plant grass on the embarkment to prevent erosion. Built across a river, a valley or low lying area to harvest and collect water.

2) **Ponds.**

Natural means of harvesting and storing water. May be used as source of drinking water for livestock or rearing fish.

Not suitable for human consumption.

3) **Roof catchment.**

Volume of water collected depends on:

a) Rainfall intensity and distribution.

The higher the amount of rainfall, the higher the volume collected.

b) Surface area provided for the water catchment.

The larger the surface area, the higher the volume of water collected

c) Gradient of the catmint area.

Where the catmint is well sloped and hard 75% of annual rainfall may be harvested.

4) **Retention ditches/level terraces.**

Artificially constructed water reservoirs serving the purpose of collecting and storing water.

5) **Use of wells.**

Holes artificially sunk into the ground below the water table to enable water to seep in for use.

6) **Rock catchment.**

Harvesting of rain water from big rocks.

Concrete channels are constructed at the base to direct water into a reservoir.

Concrete wall may be constructed around the rock to act as a tank and water taps are fitted to the wall to drain the water. E.g. Mutomo in Kitui, Mwingi and Makueni.

7) **Micro climate.**

Micro-environments designed to enhance conserving soil and water around growing crops like bananas or citrus tree crops.

CHAPTER SIX.

WEEDS AND WEED CONTROL.

Weed.

Any plant growing where it is not required and whose economic disadvantages outweigh the advantages.

- **Noxious weed.**

Weeds that are dangerous and whose cultivation is prohibited by law.

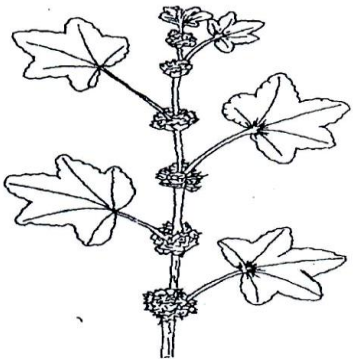
- **Self-setters.**

Crops that volunteer to row without having been planted.

.

Bracken fern.

(*Pteridum aquilinium*)

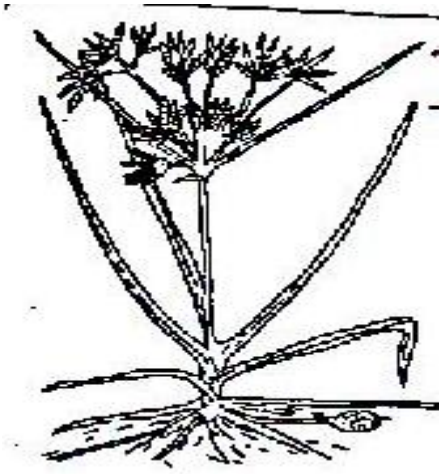


Mallow.

(Malva verticuillata)

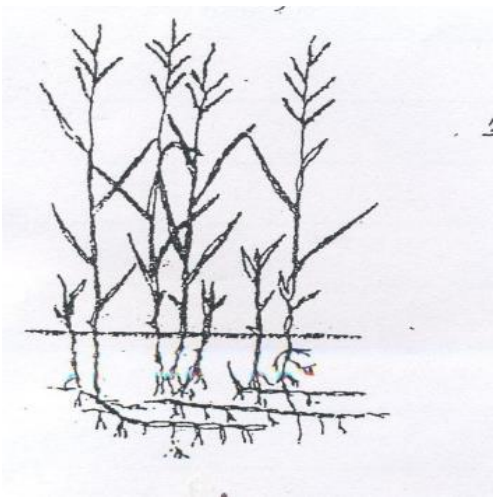
Chinese lantern.

(*Nicandra physalodes)*



Nut grass (sedge)

(*Cyprus rotundus)*

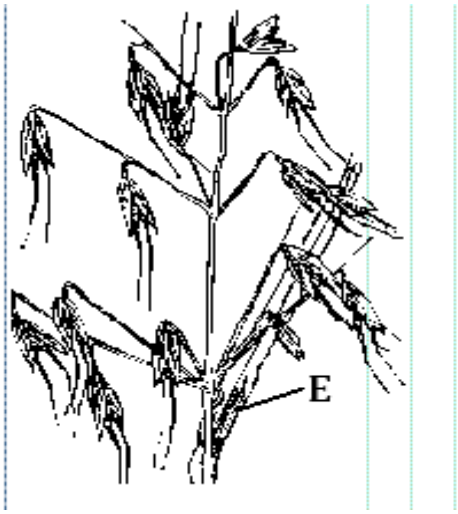


Couch grass.

Sodom apple

(*Digetaria scalarum)*

(Solanum incanum)

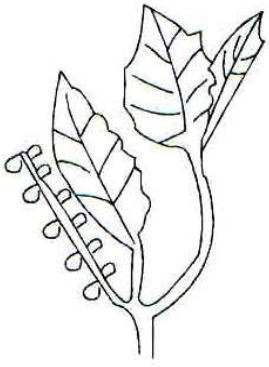


Wild oat.

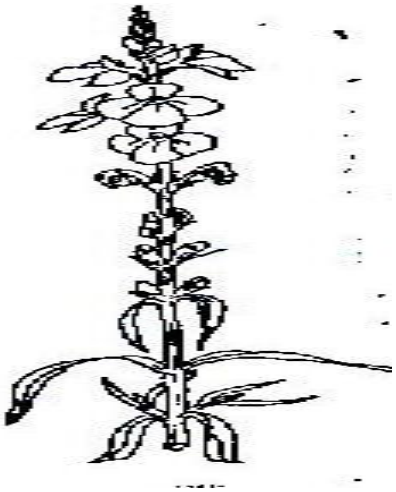
(*Avena fatua*)

Thorn apple.

(*Datura stramonium)*



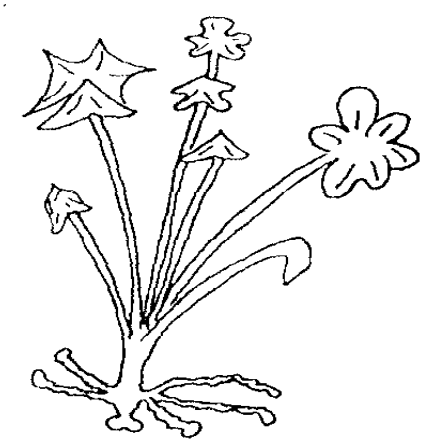
Double thorn



(Oxygonum sinuatum)

Striga (witch weed)

(*Striga hermontheca)*



Oxalis (sorrel).

(*Oxalis latifolia)*

Devil's Horse Whip.

(Acyranthes aspera)

Stinging Nettle.

(*Urtica massaica)*

Black jack.

(Bidens pilosa)

EXAMPLES OF WEEDS AND THEIR EFFECTS.

1. ***Oxalis latifolia.*** **(Oxalis/sorrel.**

Has underground bulbs thus is difficult to control.

2. **Double thorn. (*Oxygonum sinuatum)***

Irritates workers thus reducing their efficiency.

3. **Thorn apple. (*Datura stramonium)***

It is poisonous when fed by livestock and human.

4. **Tick berry. (*Lantana camara)***

It is an invasive species.

5. **Sodom apple. (*Solanum incanum)***

Poisonous to livestock and human.

6. **Couch grass. (*Digetaria scalarum)***

Has underground stems/rhizomes that makes it difficult to eradicate.

Control measures.

- Use of appropriate herbicides.
- Digging using a fork jembe as a jembe cut the rhizomes instead of removing them.

7. **Black jack. (*Bidens pilosa)***

The seeds sticks on people's clothes as well as on the wool of sheep which lowers its quality.

8. **Mexican marigold.** ***(Tagetes minuta)***

Taints milk when fed before milking.

9. **Striga. (*Striga hermontheca)***

Parasitic weed of grass family which sucks nutrients from the crop.

Control.

- Alternating/crop rotation/planting crops belonging to other family.

WEED CLASSIFICATION.

Classified on two basis:

- Growth cycle.
- Plant morphology.

Classification based on growth cycle.

- Annual weeds.
- Biennial weeds.
- Perennial weeds.

Annual weeds.

Weeds that compete their lifecycle within a period of one year or less.

Examples.

- Pig weed.
- Mexican marigold.
- Gallant soldier.
- Black jack.

Are easily controlled especially if controlled before flowering.

Biennial weeds.

Weeds that take two years to complete their life cycle.

The first year is the vegetative phase/growth while the second year is the reproductive phase.

Examples.

- American wild carrot.
- Spear thistle.

Perennial weeds.

Weeds that takes more than two years or seasons to complete their life cycle.

Examples.

- Sodom apple.
- Tick berry.
- Kikuyu grass.
- Wandering Jew.
- Couch grass.

Are the most difficult to control.

Classification based on plant morphology.

- Narrow-leaved weeds.
- Broad-leaved weeds.

Narrow-leaved weeds.

Have narrow leaves. Are mostly grass weeds.

May be perennial or annual.

Examples.

- Couch grass.
- Spear grass.
- Setaria.

Broad leaved weeds.

Have broad leaves. May be annual or perennial.

Examples.

- Black jack.
- Oxalis.
- Tick berry.
- Pig weed.

COMPETITIVE ABILITY OF WEEDS.

1. **Weeds have extremely successful means of propagation these include.**

- Ability to produce large quantities of seeds. E.g. black jack and pig weed.
- Weed seeds remain viable in the soil for a long time awaiting conducive environment.
- Most seeds are easily and successfully propagated vegetatively. E.g. couch grass, wandering jew.

2. **Weeds are excellently adapted to the environment due to:**

- Elaborate or extensive root system for nutrients and water uptake.
- Ability to survive even where there is limited nutrient supply.
- Short life cycle.

HARMFUL EFFECTS OF WEEDS.

1. Weeds compete with crops for nutrients, space, light and soil moisture thus reduces crop yield.
2. Some weeds e.g. Striga are parasitic to cultivated crops such as maize.
3. Some weeds lowers quality of agricultural produce e.g. Mexican marigold gives undesirable flavours in milk. Black jack, forget-me-not, get attached to sheep wool thus lowering its quality.
4. Some weeds are poisonous to man and livestock. E.g. thorn apple. Sodom apple. Flower of the hour (Hibiscus *trionum)* and Abutilion (*Abutilion maurianum).* Are alternate host to cotton stainers.
5. Some weeds acts as alternate host for insect pest and diseases. E.g. wild oats is alternate host rust.
6. Some weeds have allelopathic that is the produce poisonous substances that suppress growth of crops.
7. Some weeds block irrigation channels making it difficult for water to flow freely in irrigated land.
8. Weeds lowers the quality of pastures e.g. tick berry suppress the undergrowth. Others reduce the palatability of herbage e.g. Nut grass.
9. Some weeds are difficult to handle and control because they irritate workers reducing the efficiency in which they are controlled. E.g. double thorn and stinging nettle.
10. Aquatic weeds e.g. Salvinia (*Salvinia auriculata)* in Lake Naivasha and water hyacinth (*Eichhornia crassipes)* in Lake Victoria, affect fishing by blocking and cut off oxygen supply to aquatic animals.

BENEFITS OF WEEDS.

1. Some are edible to both man and livestock. E.g. pig weed and wandering jew.
2. Leguminous weeds fix nitrogen in the soil.
3. Some have medicinal effects e.g. Sodom apple.
4. Weeds add organic matter to the soil when they decompose.

WEEDS CONTROL METHODS.

Determined by:

- Type of weeds to be controlled.

- Weather condition.
- Capital available.
- Effects of the control method on the environment.

Methods include:

1. Chemical weed control.
2. Mechanical weed control.
3. Cultural weed control.
4. Biological weed control.

CHEMICAL WEED CONTROL.

Use of herbicides to control weeds.

Mechanism of herbicides in killing weeds.

1. **Inhibition of Nitrogen metabolism.**

Some herbicides may interfere with formation of DNA, RNA reducing nitrogen metabolism. E.g. glycophosate.

2. **Killing the cell.**

Depends on ability of herbicides to penetrate into the cell wall which eventually penetrate the cytoplasm killing it.

3. **Causing Abnormal Tissue Development.**

E.g. twisting and gall formation. Some are growth regulators that interferes with plant growth. E.g. benzoic acid, 2, 4-D.

4. **Inhibiting respiration.**

Some block movement of materials from site of manufacture to other areas. E.g. Dinozebs.

CLASSIFICATION OF HERBICIDES.

Methods of classification.

- Formulation.
- Time of application.
- Selectivity.
- Mode of action.

1) **Classification based on formulation,**

Formulation. Physical form of herbicide.

a) **Liquids.**

Soluble in water or oils. Are highly concentrated and toxic. E.g. paraquat.

b) Wettable powders.

Finely grounded particles. Mix with water to form a suspension before application.

Spreader. Substance which causes particles to disperse and not stick together forming clusters. Prevent flocculation and helps the herbicide to spread when applied on the surface.

To avoid clustering, constant agitation is also necessary.

Examples. Atrazine, Simazines and Duron.

2) Classification based on time of application.

a) Pre-emergence.

Herbicides applied soon after sowing crop seeds but before germination. Kills weeds that may have germinated for crops to germinate in a weed-free seedbed.

b) Post- emergence.

Applied after crop germination or transplanting at different of crop growth.

Examples. Paraquat, glyphosate and 2, 4-D.

3) Classification based on selectively.

a) Selective herbicide.

Kills the target plant/weeds and leaves the crops.

b) Non –selective herbicide.

Kills even the crops.

Selectivity is dependent on susceptibility/ tolerance of individual plant species.

4) Mode of action.

a) Contact herbicides.

Kills only the part of plant which it comes into contact with.

b) Translocated/systemic herbicides.

Kills the whole plant even if it comes into contact with only a small part.

FACTORS AFFECTING SELECTIVITY AND EFFECTIVENESS OF HERBICIDES.

a) Stage of growth.

Young plant are more susceptible to herbicides due to their high activity.

b) PLANT MORPHOLOGY AND ANATOMY.

i. Leaf angle.

Plants with more inclined leaf angles e.g. grasses retain less herbicides compared to those with horizontal angles e.g. dicots. Thus are less susceptible to herbicides.

ii. Location of growing points.

Terminal buds and growing points are exposed in dicots but enclosed in grasses making dicots more susceptible.

iii. Difference in root systems.

Deep-rooted weeds requires herbicides with a long residual effect while shallow rooted weeds are more susceptible to herbicides.

iv. Differential heights of plants.

If weeds are shorter than crops or vice versa, selectivity can be attained. E.g. spraying weeds under coffee bushes.

v. Nature of leaf surfaces.

Plants with thick cuticles and waxy surface retain less herbicides.

vi. Method of application.

High selectivity is attained by placing the herbicide where the weeds are and away from the crops.

vii. Formulation.

Oil formulation are more toxic to plants.

viii. Concentration.

Herbicide that is at high concentration is likely to kill all kinds of plants.

ix. Physiological/metabolic factors.

Some plants e.g. beans have poor rate of absorption and translocation of 2.4-D while others have ability to neutralise toxic materials.

c) Environmental factors.

i. Wind.

May blow away spray to unintended plants while decreasing chemical concentration on the intended plants.

ii. Rain.

May dilute/wash away chemicals to nontoxic levels if it falls immediately after application.

It may also leach and reach to the roots of deep-rooted plants thus killing them.

iii. Soil.

Some soils absorb and retain herbicides more than others. Thus higher dosage will be required.

iv. Light.

Increase in light intensity increases rate of light absorption and photosynthesis by plants increasing absorption and translocation of herbicides.

Some herbicides are decomposed by high light intensity hence becoming less effective.

v. Temperature.

Increases translocation, hence absorption of more herbicides.

SAFETY PRECAUTIONS IN USE OF CHEMICALS.

a) Precautions to the user.

i. Read manufactures' instruction and follow them.
ii. Wear protective clothing such as overall, breathing mask, gloves and boots.
iii. Avoiding inhaling the herbicides by:
- Not spraying against the wind.
- Not smoking while spraying.
- Wearing breathing mask.

i. Take a thorough bath after handling chemicals.
ii. Do not blow or suck blocked nozzles.

b) Precautions to prevent dangers to environment and other people.

i. Avoid herbicide drift to unintended crops by not spraying on windy days.
ii. Drift to animal feeds and water should be avoided.
iii. Avoid spilling herbicides on pastures and fodder crops.
iv. Empty containers must be properly disposed off e.g. by burying them.
v. Spraying equipments should not be washed in water sources which are used by animals and humans.
vi. Store chemicals in safe place out of reach of children and away from food.

vii. Equipments used in spraying herbicides should be washed to prevent killing of the next crop by herbicides remaining in the pump.

Advantages of using herbicides.

a) Require less labour than mechanical cultivation.
b) Makes control of weeds in certain crops such as wheat, barley and carrots easier.
c) Herbicide application is efficient in both wet and dry soil conditions unlike mechanical cultivation.
d) Herbicides application does not disturb the soil hence soil structure is maintained.
e) They are more convenient to use in crops like sisal and sugarcane and in controlling weeds such as double thorn and stinging nettle that cause injury to the farmer.
f) Herbicides are better adapted to the control of certain bothersome weeds e.g. couch grass and sedges.
g) Herbicides do not disturb crop roots and other underground structures.
h) It is cheaper in the long run than use of mechanical cultivation.

Disadvantages of using herbicides.

a) Some have a long residual effect which may interfere with future crops.
b) There are many risks to the environment and to the user.
c) Require skilled labour in mixing and application.

MECHANICAL WEED CONTROL.

a) Tillage (cultivation)

The purpose is to desiccate the weeds by exposing the roots to air. Can be achieved by use of hand tools or tractor implements.

Tillage buries weeds thus killing them.

Weeding should be done before weeds have flowered and produce seeds to break their life cycle.

Advantages of tillage in weed control.

i. It is cheap and thus a good option to small scale farmers.
ii. During tillage, crop residue is incorporated into the soil.
iii. Tillage opens up the soil allowing infiltration of water to occur thus minimising soil erosion.
iv. During tillage, earthing up is done and this encourages root growth.

Disadvantages of tillage in weed control.

i. Tillage may not effectively control weeds, especially the perennials.
ii. Tillage creates suitable conditions for weeds to germinate.
iii. Excessive weeding may lead to water loss, soil erosion and damage to crops roots.
iv. Excessive tillage pulverises the soil thus destroying soil structure.

b) Slashing (mowing)

Mechanical removal of shoots from weeds.

Effective in control of annual weeds especially if done repeatedly.

c) Uprooting.

Done where weeds are scattered or where the crops are too close to allow mechanical cultivation.

CULTURAL WEED CONTROL.

a) Cover cropping.

They smoother the weeds suppressing their growth.

b) Crop rotation.

Some weeds are associated with certain crops. E.g. Witch weed in grass family thus should be rotated with dicots.

c) Mulching.

Smoothers weeds, thus preventing their growth.

d) Timely planting.

Allows crops to establish early before weeds thus smothering them.

e) Use of clean seeds/planting materials.

Prevents introduction of weeds to the farm land.

f) Clean seedbed.

This start off the crops on a clean bed so that they effectively compete with weeds.

g) Flooding.

Discourage growth of non-aquatic weeds.

h) Proper spacing.

Creates little space for weed growth and forms a canopy that suppresses weeds.

BIOLOGICAL WEED CONTROL.

Involves use of living organisms to control weeds.

Should be used in combination with other methods.

Examples.

- Use of livestock e.g. goats to graze and control growth of weeds in plantation crops such as coconuts and cashew nuts.
- Use of certain weed eating fish to control aquatic weeds.
- Use of moths to control cactus.

LEGISLATIVE WEED CONTROL.

Involves use of governmental laws and acts to prevent introduction of noxious weeds in a country.

CHAPTER SEVEN.

CROP PESTS AND DISEASES.

CROP PESTS AND THEIR CONTROL.

Crop pest.

Living organism that destroys crops either directly by causing physical damage or indirectly by introducing disease-causing organisms into crops.

HARMFUL EFFECTS OF CROP PESTS.

1) Pests like squirrels and mice unearth planted seeds resulting in low plant population.
2) Some e.g. nematode, termites and moles damage crop roots causing wilting and death of plants.
3) Pests destroy crop leaves lowering the photosynthetic area resulting in reduced yields.
4) Sucking pest deprive the plants of its food by sucking plant sap resulting in retarded growth.
5) Some pests attack fruits, berries and flowers, thus lowering their quality and quantity.
6) Some pests destroy the embryo of seeds, thus lowering their germination potential.
7) Some transmit crop diseases e.g. aphids and mealy bugs transmit viral diseases while wounds caused by pests' acts as route of secondary infection.
8) Some pests e.g. stalk borers, eat the growing points causing retarded growth.
9) In crops where the leaf is the major product, pest damage lowers the quality and quantity through defoliation.
10) Pests reduce the marketability of crop produce by lowering quality e.g. weevils bore into maize grains lowering their economic value.

CLASSIFICATION OF PESTS.

1. **Their mode of feeding.**

This is determined by the nature of their mouth parts:

- Those with biting and chewing mouth parts.
- Those with piercing and sucking mouth parts.

2. **Crops attacked.**

Most pests are crop specific. That is prefer certain crops or a family of crops. E.g. coffee pest.

3. **Stage of development of the pest.**

Some pests are harmful to crops when they are in the larval or nymphal stage while others affect crops during their adult stage.

Most attack at larval stage such as moths and butterflies.

4. **Stage of growth of the crop attacked.**

Some pest attacks the crops when it is young and tender while others attack the crop at flowering or when mature. E.g. cutworm after transplanting and American bollworm at flowering stage or the fruits.

5. **Scientific classification.**

May be classified according to their scientific grouping. E.g. insects, birds, nematodes, mites etc.

6. **The level of damage.**

Some cause less damage to crops thus called minor pests while others causes great damage thus called major pest.

7. **The place where they are found/habitat.**

May be classified according to their ecological niche or where they are found.

Some pest cause damage to the crops while in the field (field pests) others cause damage to stored produce. (Storage pest)

IDENTIFICATION OF COMMON PESTS.

a) **Insect pest.**

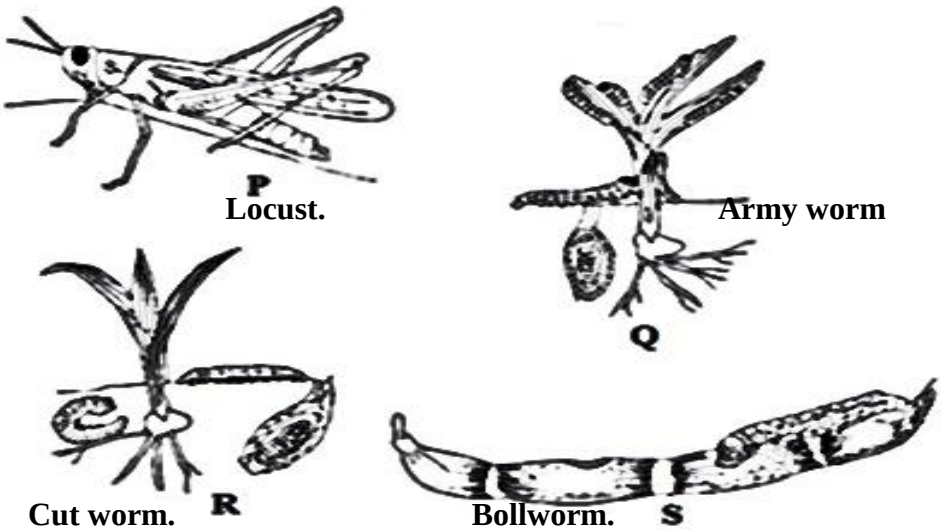
Most destructive class of tropical pests. More serious in tropics as tropical conditions are ideal for their breeding.

Some are beneficial e.g. pollinators and pest predators.

Damage caused by insect pest depend on feeding habits of the insects.

i. **Insects with biting and chewing mouth parts.**

Include: locusts, grasshoppers, crickets, and maize stalk borers, army worms, cut worms, bollworms and termites.



Have specialised biting and chewing mouth parts with developed cutting and grinding teeth.

Damages caused.

a) **Leaves.**

Damage on leaves reduces photosynthetic area of plant lowering yields.

Reduces quality in leaf vegetable.

b) **Stems.**

Damage interferes with transport system leading to death of plant. May cut and lead to falling of stems.

c) **Roots and tubers.**

Affect nutrients and water uptake. Lowers quality of tubers e.g. sweet potato attacked by weevils.

d) **Flowers and fruits.**

Leads to their fall also reducing quality of those that do not fall.

ii. Insects with piercing and sucking mouth parts.

Includes: aphids, scales, adult stages of butterflies and mouth, cotton leaf hoppers, mealy bugs and thrips.

Have mouth parts modified into needle-like stylet that the use to suck sap.

Effects.

Introduction of disease causing organisms e.g. viruses and fungi present in their saliva.

Some inject toxic saliva which may cause distorted growth in plants e.g. antestia bug in coffee.

Name of pest.	**Crop attacked.**	**Disease transmitted.**
Aphids (*Aphis crassivora)*	Groundnut.	Groundnut rosette virus.
Aphids (*Aphis persicae)*	Groundnut.	Groundnut mosaic virus.
Aphids (*Myzus persicae)*	Tobacco.	Tobacco mosaic virus.
Tobacco whitefly. (*Bemisia tabaci)*	Tobacco.	Tobacco leaf curl virus.
Tobacco whitefly. (*Bemisia tabaci)*	Cassava.	Cassava mosaic virus.
Pineapple mealy bug. (*Dysmicoccus brevipes)*	Pineapple.	Pineapple virus.

b) Mites.

Order: Acarina.

Class: arachnida.

Lack wings and antennae, have four pairs of legs and two body parts (Cephalothorax and abdomen)

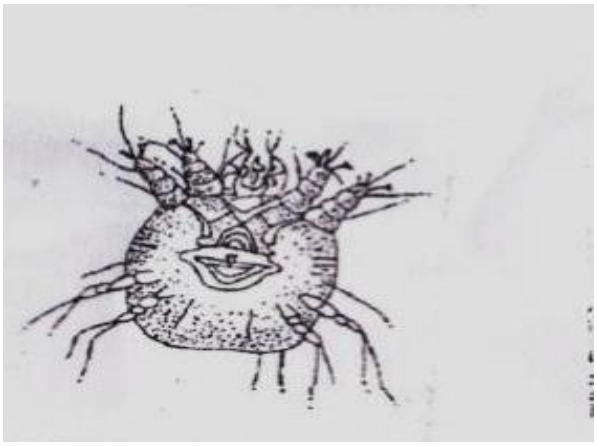
Adapted to piercing and sucking. Some are microscopic.

They are primarily parasitic. Are moved from one place to another by wind due to their small size. They usually attack underside of leaves.

Examples.

- Red spider mite.
- Yellow tea mite.

Their population is lowered by natural enemies.



c) Nematodes.

Legless worms with elongated and unsegmented bodies. Belong to class Nematoda

Some are free-living while others are parasitic in plants (eelworms) and animals (Ascaris).

Have separate sexes. Have mouth parts modified into stylet adapted for piercing and sucking.

Attack leaves, stems, roots and bulbs.

Examples.

Meloidogyne spp **attack solanacea family crops.**

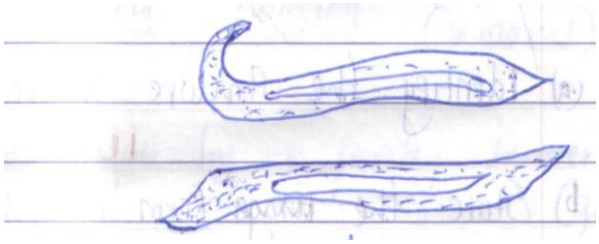
Practylenchus spp **attack pyrethrum leaves.**

Damages by nematodes.

1. Injecting toxic substances into the plant tissues stimulating structures like galls (swellings).

E.g. *Meloidogyne spp.*

2. Galls do not rub off easily unlike root nodules. Galls block xylem vessels restricting water movement leading to wilting.
3. Some feed on plant roots causing root stunting limiting water and nutrients uptake. This causes wilting which is severe in dry spell and when crops are young.
4. Causes wounds in plant tissues through which secondary infection may take place.



d) Rodents.

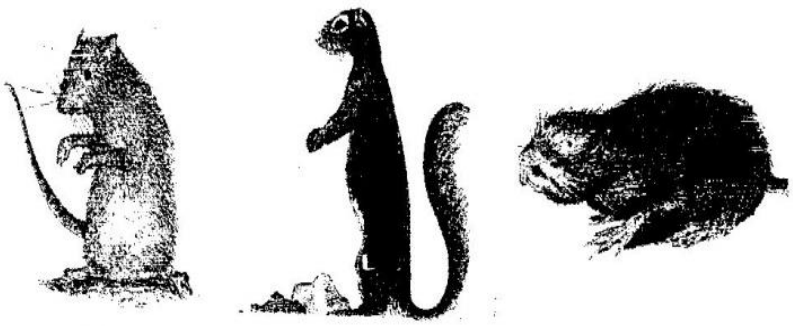
Gnawing mammals. Include squirrels, moles, cats, porcupines, field mice and hares.

Have specialised teeth for gnawing hard substances such as grains.

Porcupines and hedgehogs are serious pests to green maize, root and tuber crops e.g. potatoes, cassava and cocoyam.

Moles eat roots and pull plants underground. Spoils pastures by covering them with soil from burrowed tunnels.

Squirrels unearth and eat sown seeds, eat roots and tubers.



M **Common rat.** N **Squirrel.** P **Mole.**

e) Birds.

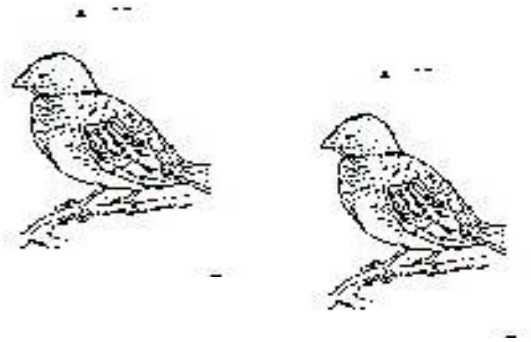
Most are grain eaters while others eat fruit.

Examples.

I. **Sudan Dioch (*Quelea Quelea aethiopica)***

Causes severe losses on sorghum, millet and other grain crop.

Move in large number thus it is considered an epidemic.



Control.

- Poisoning.
- Use of explosives.
- Resistant varieties e.g. gooseneck sorghum varieties.

II. The common weaver bird.

Causes serious damage on grains. Causes serious damage to the maize crops at milky stage.

III. Mouse bird.

Damages fruit crops (most serious fruit eating bird)

Damage bean seedlings in early stages.

IV. Domestic fowl.

Become pests when not properly reared. Cause damage to flowers, pods, grains, leaves and tubers.

f) Large animals.

Wild animals such as elephants, buffaloes, monkey, hippos etc.

STORAGE PESTS.

Pests which cause damage to crops while in store. Include: rodents, insects and fungi.

Rodents.

Common rat (*Rattus rattus)* and giant rat. (*Cricetomy gambianus)*

Cause damage to grains in store by eating and contaminating the grains with excreta.

Harbour fleas that transmit bubonic plague to human.

Insects.

Include: maize weevils, beans bruchids, grain borers and floor beetles.

True maize weevil.

Species.	**Scientific Name.**	**Stored crop affected.**
Weevil.	*Stiphilus spp*	Maize, sorghum, wheat, rice.
Lesser grain borer.	*Rhizoperita dominza*	Rice, maize, wheat.
Khapra beetle.	*Trogederma grananium*	Maize, wheat, pulses, sorghum.
Saw-toothed grain beetle.	*Orzaephilus spp*	Maize, wheat, groundnut.
Pulse beetles.	*Callosobruchus obtectus*	Beans.
Flat beetles.	*Laemophiloeus pusillus*	Grain flour.
Aqoumois grain moth.	*Sitotraga cerealella*	Maize, wheat.
Tropical/warehouse moth.	*Epestia coutelle*	Rice, maize, wheat.
Potato tuber moth.	*Pthorimaea operculella*	Stored Irish potatoes.

Termites are also storage pests.

Fungi.

Causes damage to stored grains that are not properly dried or in a damp store.

Include: penicillum and Aspergillus.

Causes:

- Food poisoning e.g. (*Aspergillus flavus)*
- Lowers seed viability.

CONTROL OF CROP PESTS.

Integrated pest management. (IPM)

Use of a combination of both chemical and cultural control methods.

Economic injury level.

Where pest population causes damage beyond tolerance and control measures have to be undertaken. Measured in terms of number of pests per plant.

PEST CONTROL METHODS.

1) **LEGISLATIVE METHOD/QUARANTINE.**

Government regulations that prevent introduction of new pests into the country. Any plant material entering the country must be inspected to ascertain it does not contain new pests.

Done by Kenya Plant Health Inspectorate Service (KPHIS) at Muguga and Mbita in south Nyanza.

2) **PHYSICAL MEASURES.**

a) **Use of lethal temperature.**

Involves use of extreme temperatures to control pests.

E.g. control of pink bollworms in cotton seeds by hot water treatment.

b) **Proper drying of produce.**

Drying of grains makes them too hard for pest to penetrate. It also discourage growth of moulds. Should be dried to 11-13% MC.

c) **Flooding.**

E.g. cut worms and army worms will drown if the field is flooded. Kills underground pests such as moles.

d) **Suffocation.**

Use of hermetic Cyprus bins and hermetic bags where CO_2 build up to suffocate pests.

e) **Physical destruction of pests.**

Hand picking or trapping and killing them. E.g. picking and killing giant loppers and trapping moles.

f) **Use of scarecrows.**

Scaring large animals and birds out of the farms.

g) **Use of physical barriers.**

Materials that prevent pests from getting into the crops. E.g. rat deflectors, construction of fences around the fields and trenches to control large animals.

h) Use of Electromagnetic Radiation.

Radiators such as radioactive radiations. Deactivates enzymes in some insects. Moths are attracted by U-V and aphids by Yellow light. Thus can then be destroyed.

CULTURAL METHODS.

Farming practices employed to alter the environment making it unfavourable for survival of pests.

a) Timely planting.

Helps crops escape pest attack e.g. maize stalk borers in maize.

b) Timely harvesting.

Some storage pests e.g. grain weevil attack crop while in the field thus early harvesting will enable it to escape attack.

c) Proper Tillage.

Field cultivation exposes pests that are soil borne e.g. white grubs to sun or predators.

d) Close season.

Period when a susceptible crop is not grown in order to control a certain pest or group of pests.

Crop residues should also be destroyed. E.g. in control of pink boll worm in cotton.

e) Trap cropping.

Trap crop. Planted before or together with the main crop purposely for attracting pests away from the main crop.

Trap crop is planted before if not preferred by the pest or planted along with the main crop if more preferred by the pest than the main crop,

f) Crop rotation.

This will starve the pest to death by rotating crops that are not preferred by the pests.

E.g. rotating maize and beans which are preferred by nematodes with groundnuts that are not preferred.

g) Planting resistant crop varieties.

Breeding has resulted into plants with natural protective mechanisms against pest attack. E.g. goose necked sorghum is resistant to birds attack and highly tillering sorghum resistant to shoot fly.

h) Field hygiene.

Keeping filed free from plant materials harbouring pests. Include: rogueing and removal of crop residues from the field.

i) Alteration of Environmental conditions.

Includes creating micro-climates not conducive to some pests. E.g. open pruning in coffee discourages antestia bugs and mulching reduces thrips.

j) Crop nutrition.

Application of fertilizers and manure makes crops strong thus able to resist and escape attack. However excessive Nitrogen makes crops succulent hence susceptible to pest attack.

k) Destruction of Alternative host.

Some weeds are alternate hosts to crop pests thus should be controlled. E.g. mallow harbours cotton stainers.

l) Use of clean planting materials.

Helps to prevent introduction and spreading of crop pests.

E.g. suckers in bananas should be free from pests such as banana weevils.

m) Proper spacing.

Proper spacing makes it difficult for pests to move from one plant to another. Closer spacing in groundnuts discourages Aphids.

n) Use of organic manure.

Effective in control of nematodes.

o) Irrigation.

Overhead irrigation controls aphids in cabbages.

3) CHEMICAL CONTROL.

Use of pesticides to control pests.

Classification of pesticides.

1) Formulation.

Form in which a pesticide is available. Includes: Wettable powders, fumigants, aerosols dusts, liquids and emulsions.

2) Target pest.

Classified according to specific pests killed by a pesticide.

Include:

- Insecticides. Kills insects.
- Nematicides. Kills nematodes.
- Rodenticides. Kills rodents
- Fungicides. Kills fungi.

3) **Mode of action.**

Include:

a) **Stomach poisons.**

Kills when the pest eat plant part sprayed/dressed with chemical. Kills biting insects. It is selective as it kills only the pests that consume the crop sprayed.

b) **Systemic poisons.**

Circulated to all parts of the pest once it has eaten the sprayed part. More selective as only the pest with systems that can circulate them are killed.

c) **Contact poisons.**

Kill pests when they are absorbed in the body through skin or cuticle.

Effective when applied directly on the target pest. Are not selective and may kill beneficial organisms such as pest predators, pollinators and decomposers.

d) **Suffocants.**

Kills by interfering with the breathing system of a pest after being inhaled. Pests with a tough cuticle need Suffocants.

Anti-feedants.

Inhibit (prevent) feeding in insects and other pests starving them to death.

e) **Repellants.**

Keep the pests away from the plant.

FACTORS AFFECTING THE EFFICIENCY OF PESTICIDES.

a) **Concentration.**

The correct concentration will be more effective in killing the target pest.

b) **Timing of application.**

Should be applied at the stage of development when the pest is most vulnerable. E.g. leaf miners at larval stage before cocoon formation.

c) **Weather conditions at the time of application.**

Rain falling immediately after application washes off/dilute the pesticide reducing its effectiveness. Apply when there is no likelihood of rain.

d) **Persistence.**

Pesticides should remain effective long enough to achieve all desired effects.

Advantages of chemical control.

- It faster compared to other methods of control.
- Results are more predictable than most other methods.

Disadvantages.

- They are expensive.
- Most are non-selective thus kill useful insects such pollinators and pest predators.
- Some develop resistance to some pesticide and thus becoming a bigger problem than before.
- Most are toxic to man, livestock and other animals. Indiscriminate use interferes with the ecosystem.
- Use of pesticides requires skill in handling and application.

4) BIOLOGICAL PEST CONTROL.

Use of living organisms to control pests. Based on predators-prey relationships. Predator is a living organism that kills another for food. Every living organism has its own natural enemies.

Predator.	**Target pest.**
Lady bird.	Aphids.
Wasps.	Coffee mealy bugs.
Preying mantis.	Giant lopper.
Majimato ants.	White scales.
Chicken.	Cotton stainers.
Cats.	Moles, rats, mice.
Chameleons.	Most insects.

CROP DISEASES AND THEIR CONTROL.

Disease.

Alteration in the state of an organism or its parts which interrupts or disrupts its proper performance or function.

Harmful effects of crop diseases.

- Lower crop yields.
- Production of quality product reducing their market value.
- Cause food poisoning e.g. ergot in wheat, barley and rye causes nerve poisoning. Aflatoxin in moist stored grains is poisonous.

CLASSIFICATION AND IDENTIFICATION OF CROP DISEASES.

Classified according to their causal agents.

Include: fungi, virus, bacteria, poor weather conditions and deficiency of essential elements.

a) **Fungal diseases.**

Diseases caused by fungi.

Fungi lack chlorophyll. Exist as parasites, saprophytes or both.

- **Obligate parasite.**

Completely dependent on other living organisms for food.

- **Facultative parasite.**

Are able to live on both the living and dead tissues.

Saprophytes live as decomposers of dead and decaying plant and animal remains.

Groups of parasitic fungi.

- Those with all the mycelia and the fruiting bodies on the surface of the host. E.g. *Erysiphe spp.* Causes Powderly mildew.
- Those with the mycelia inside the plant tissues and the fruiting bodies on the surface of the host. E.g. *Phytophthora infestans. Puccina spp.* And *Ustilago spp.*
- Those having the mycelia and fruiting bodies all inside the host. E.g. *Fusarium spp.*

Examples of common fungal diseases.

Late blight.

Caused by *Phytophthora infestans.* Attacks solanacea family especially Irish potatoes and tomatoes.

Develops a network of many small branching hyphae in leaves and other parts.

Feed by sending hyphae (haustoria) into the host cell.(Absorbs plant sap leading to death of cell)

Reproduce by spores and spread quickly in warm moist conditions. Spores are transmitted by wind or raindrop splashes.

Symptoms.

- Dry patches (necrotic lesions) on leaves and fruits.
- Affected fruits appear rotten and falls prematurely.

Control.

Spray copper based fungicides.

Rusts.

Caused by *Puccina spp.* E.g. *Puccina graminis, Puccina sorghi. Puccina polysora.*

Symptoms.

- Infected leaves have red or brown pustules.
- Field appear rusty.

Pustules on leaves reduce photosynthetic area resulting in low yields.

Control.

Spraying copper fungicides and Bordeaux mixture.

Smuts.

Caused by *Ustilago spp.*

- *Ustilago zeas.* In maize.
- *Ustilago scitiminea* in sugarcane.
- *Ustilago noda* in wheat.

Produces large number of black spores that forms black masses on maize tassels and cobs.

Control.

- Hot water treatment of barley and wheat seeds.
- Use of certified seeds.
- Crop rotation.
- Field hygiene.

Coffee berry disease. (CBD)

Colletrotrichum coffeanum. Attacks Arabica coffee.

Causes crop losses up to 80%.

Favoured by high rainfall, high relative humidity and cold temperatures.

Symptoms.

- Flowers have a dark brown blotch or streak on the white petal.
- Green berries have small dark sunken patches or lesions that spread rapidly and cover the whole berry.
- Infected berries drop to the ground or remain on the tree in a black mummified condition.
- Berries are empty.
- Ripe berries have dark sunken patches with minute black dots.
- Serious infection is on berries that are spreading.

Control.

- Use of appropriate copper fungicides. Start before onset of rains and should be repeated every four weeks.
- Open pruning.

Other fungal diseases.

- Powdery mildew.
- Fusarium wilt.
- Root rot.
- Downy mildew.
- Early blight.

b) Viral diseases.

Caused by viruses.

Viruses are extremely small living organisms. All are parasitic. They are obligate parasites. When outside living tissues, viruses form spores (cysts) and live in inactive form for many years.

Symptoms of viral infection in plants.

a) **Leaf chlorosis.**

Due to impairment of the plants ability to synthesise chlorophyll.

b) **Leaf curling.**
c) **Mosaics.**

Production of light green or yellow patches of various sizes and shape. Irregularly distributed among normal tissues.

d) **Malformations.**

Distortion of plant parts e.g. small leaves, galls and overgrowth on leaf lamina.

e) **Rosetting.**

Development of abnormally short internodes resulting in stunted plants.

Transmission of viral diseases.

- Use of infected vegetative materials.
- Insect vectors (sucking mouth parts)

Examples of viral diseases.

- Cassava mosaic.
- Brown streak of cassava.
- Potato leaf roll.
- Tobacco mosaics.
- Groundnut rosette.
- Greening disease of citrus fruits.

c) **BACTERIAL DISEASES.**

Bacteria are microscopic single celled organisms that reproduce by binary fission.

Transmission.

- Irrigation water.
- Seeds, fertilizers, manure and wind.
- Rain splashes.
- Insects.
- Cultivation implements and pruning knifes.

Symptoms.

- Wilting due to blockage of xylem vessels by masses of bacteria.
- Cankers. Localised infections resulting in death of plant tissues (necrotic tissues)
- Gall formation in infected tissues.

Examples of bacterial diseases.

Bacterial Blight of Coffee. (BBC)

Caused by: *Pseudomonas syringe.* Found on plant surfaces (leaves and green shoots.

Enters through the stomata and wound. It is severe at high altitude.

Symptoms.

- Necrotic lesions which when active, have water-soaked margins.
- On shoots it causes die back originating from flowering nodes and shoots.
- Infection on mature bark and wood resulting in cankers that girdle the main stem killing the whole plant.
- Fine scorch appearance in epidermis.

Control.

- Use of appropriate chemicals e.g. supanil dust before, during and after flowering.

Other bacterial diseases.

- Black rot of cabbage.
- Black arm of cotton.
- Bacterial wilt of potatoes, tomatoes etc.
- Halo blight of beans.

d) Nutritional disorders.

Deficiency symptoms.

- Yellowing of leaves.
- Drying of leaves.
- Falling of leaves, flowers and fruits.
- Stunted growth.
- Death in extreme conditions.

e) Other causes of crop diseases.

- **Flooding.**

Ammonia is poisonous to plants. Has a burning effect on leaves.

- **Chemicals.**

Some toxic chemicals in soil may lead to death of plants.

- **Poor weather.**

Extremes of day and night temperatures cause Hot and Cold disease in coffee. (Elgon Die Back).

- **Stress.**

Stressful conditions e.g., irregular watering causes blossom-end rot in tomatoes.

CONTROL OF CROP DISEASES.

1) CULTURAL METHODS.

- Using healthy planting materials.
- Filed hygiene such as burning of diseased crop residues.
- Proper seed bed preparation to control armillaria root rot in tea and coffee.
- Proper spacing to control damping off in cabbage seedlings in a nursery bed and rosette disease in groundnut closer spacing is used.
- Heat treatment e.g. in control of ratoon stunting disease in sugarcane.
- Proper drying of cereals and pulses before storage.
- Use of disease resistance varieties e.g. Ruiru 11 and batian resistant to CBD and coffee leaf rust.

2) LEGISLATIVE METHOD.

Imposing regulations and laws to prevent introduction and spreading of diseases.

3) CHEMICAL CONTROL.

a) Seed dressing.

Application of fungicides before planting seeds.

b) Soil fumigation.

Application of fumigants in the soil to control soil borne pests e.g. bacterial wilt.

c) Spraying.

Application of fungicides to control diseases.

CHAPTER EIGHT.

CROP PRODUCTION VI

FIELD PRACTICES II

MAIZE (*Zea mays*).

Staple food. Also used as livestock feed. It is processed to produce oil and starch.

ECOLOGICAL REQUIREMENTS.

Altitude of 0-2200M above the sea level. Prefers medium temperatures and rainfall.

Prefers fertile alluvial or loam soils that are free draining, does not tolerate water logging.

pH neutral or alkaline (6.5-7.0)

Varieties.

Few varieties. Hybrids and composites are grown.

- **Kenya flat complex.**

Variety low yielding but has good sheathing cover.

- **Hybrid.**

Bred by crossing inbred lines or varieties under controlled pollinations.

- **Composites.**

Bred by growing a number of varieties together under uncontrolled pollination.

Hybrids and composites are altitude specific. Include:

- Medium to high altitude. Kitale hybrids such as H614, H622, H626.
- Embu hybrids for medium altitude. Such as H511, H513.
- Katumani composites for lower altitude zones.
- Coast composites such as Pwani hybrids 1 and 4.
- Double cob varieties such as DH01 and DH02.

Selection and preparation of planting materials.

Buy fresh seeds for every planting season because of reduced hybrid vigour in the F_1.

Land preparation.

Prepared early to allow stubble enough time to rot.

Harrowing is done where seed bed is rough (to medium tilth)

Continuous cropping should be avoided because it takes a lot of fertility from the soil.

FIELD OPERATIONS.

Planting.

Done early on onset of rains or dry planting in areas with a short rainy season.

Early planting reduces attack by stalk borers.

Depth of planting is 2.5CM-10CM. one or two seeds per hole at a spacing of 75-90CM.

75CMX30CM- 2 seeds per hole OR 75CMX15CM- 1 seed per hole. For high rainfall potential areas.

90CMX30CM 2 seeds per hole. OR 90CMX 15CM 1 seed per hole. For low rainfall potential areas.

Fertilizer application.

100-q50Kgs of DSP, DAP OR NPK 23:23:0 per Ha is applied during planting.

Topdressing with CAN or SA when the plants are 45CM or knee high or split application at 45cm and before tasselling at 200kg/ha.

Organic manure also applied. (Well rotten and mixed with soil in planting furrows/holes.

Weed control.

Keep seedbed weed free to avoid competition for growth resources.

2-3 weeding done manually or using herbicides e.g. Simazines (pre-emergent) 2,4-D (post-emergent).

PEST AND DISEASE CONTROL.

PESTS.

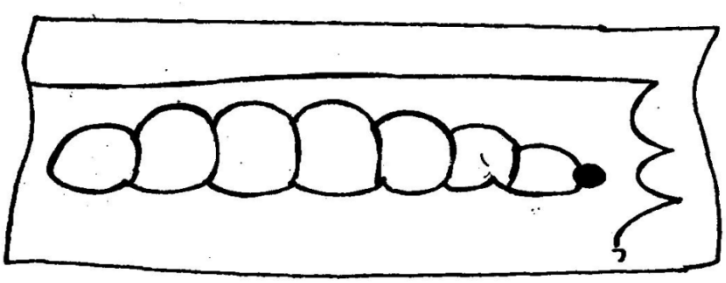
a) **Maize stalk borers (*Buseola fusca)***

Larval stage of a moth. Makes holes in leaves resulting in windowing. (In early stages).

In older plants, some caterpillars bore into stems and cobs.

Control.

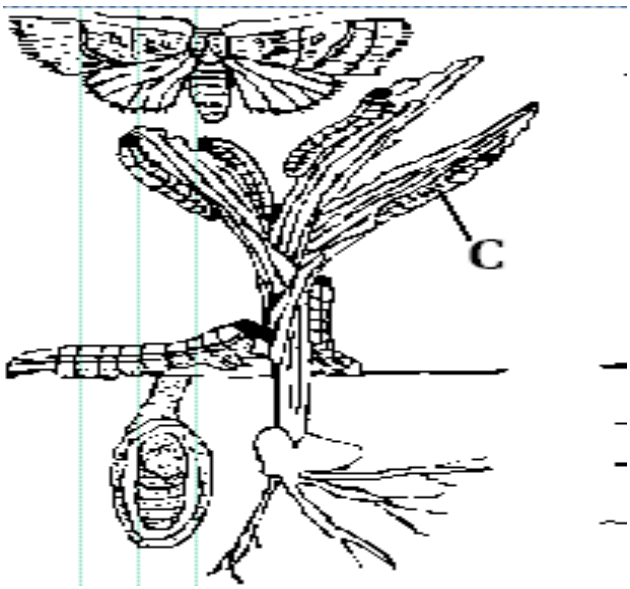
- Early planting.
- Rogueing.
- Burning infested maize crop remains after harvesting.
- Use of appropriate pesticides at funnel of each plant.



b) **Army worm. (*Spodoptera exmpta)***.

Larvae of a moth. Occurs as an epidemic and move in large numbers. Are greyish-green in colour with black stripes at the back and both sides.

Eat leaves causing defoliation and only midribs are left.



Control.

Dusting with appropriate pesticides.

c) Aphids.

Suck sap from the green husks of cobs and leaves. Attacked leaves and husks appear black in colour.

Control.

Use appropriate insecticides.

d) Birds.

Eat grains at silky stage.

Removal of husks by birds allow water to get in and cause rotting.

Control.

Scaring them away.

STORAGE PESTS.

a) Maize weevil. (*Sitophilus zeamais)*.

Most serious storage pest. May attack maize while still in the field.

Makes tunnel beneath the seed coat and circular holes of the surface of the grain.

Control.

- Dusting shelled maize with Malathion.
- Proper storage hygiene (removing previous plant debris from the store).
- Use hermetic storage bags.

b) Red flour beetle. (*Tribolium castaneum).*

Small reddish-brown beetle. Feeds on flour and damaged/broken grains.

Control.

Proper storage hygiene.

c) Rats. (*Rattus rattus).*

Attacks stoked and fallen maize and is more serious in store.

Control.

- Using rat proof stores, cats, traps and baits.
- Clearing bushes around the store.

Diseases.

White leaf blight.

Fungal disease caused by (*Helminthosporium turcium)*. Causes oval, grey and thin lesions on leaves.

Control.

Use of resistant varieties.

Maize streak.

Caused by a virus spread by grasshoppers. Causes yellow longitudinal stripes that run parallel to the midrib.

Control.

- Use of certified seeds.
- Early planting.
- Rogueing.

Rusts.

Caused by *Puccina sorghi* and *Puccina polysora.* . Forms red/brown pustules on leaves.

Control.

Use resistant varieties.

Smut.

Fungal disease caused by (*Ustilago zeas)*. Destroys grains and tassels causing masses of black powder.

Control.

Crop rotation.

Harvesting.

Takes 3-9 months depending on variety.

Stalks may be cut and stoked in the field to allow cobs to dry properly. Cobs are removed and placed in store.

De-husking directly in the field without stoking is common. Can be done by use of combine harvesters. Dry seeds to 12-13% moisture content.

Yields 3,000-4,500Kgs per Ha.

Storage.

Seeds should be dried properly to reduce chances of rotting and minimise insect damage.

Marketing.

Done by NCPB where farmers sell their maize grains. Private buyers, maize dealers and livestock food companies may buy directly from farmers.

FINGER MILLET. (*Eleusine covanaca).*

Can be stored for long (10years) without use of insecticides as it has seeds that dry out quickly and insects cannot fit inside them.

ECOLOGICAL REQUIREMENTS.

Can tolerate drought in early stages of growth but requires adequate moisture after first month.

Rainfall 900mm annually. Requires fertile free draining soils.

Varieties.

The latest variety is the ultra lupin.

Selection and preparation of planting materials.

Harvested grains are sun dried, threshed, winnowed and stored for use as seeds.

Certified seeds are available from Kenya Seed Company.

Land preparation.

Prepared early removing all perennial weeds. The land is harrowed to a fine tilth.

Weed control is very difficult thus thorough seedbed reduces competition.

Field operations.

Planting.

Plant early to increase the yield. Broadcasted by hand or planted in rows 30-33Cm apart and the plants thinned to 5Cm apart.

Commonly grown as pure stand.

Weed control.

Done manually as it is closely spaced and a jembe cannot be used. Thorough seedbed preparation and sowing in rows reduces the labour required for weeding.

Eleusine africana and Eleusine indica. Are difficult to distinguish from the crop in the early stages of growth.

Fertilizer application.

125Kg/ha of SA applied at 15Cm high increase yield from 450 to 900Kg/ha.

Pest and disease control.

Pests.

The major pest in the field are birds. It is rarely destroyed by pests in the store because of their small size.

Diseases.

Head blast.

Caused by (*Piricularia oryzae*).

Common under hot and humid conditions. Causes brown spots with grey centres on leaves, stems are affected below the inflorescence.

Control.

Use resistant varieties.

Harvesting.

Hand knives are used for cutting individual heads.

Heads are dried, threshed and winnowed. Yields 1650Kg/Ha.

BULRUSH MILLET. (*Pennisetum typhoides).*

Ecological requirements.

Drought resistant and thrives in areas of low rainfall 500-600mm per annum.

Requires warm climate which is prevalent in altitude below 1200M above the sea level.

Requires well drained soils and will perform well even when they are not rich in nutrients.

Varieties.

There are some varieties that are high yielding and disease resistant from Uganda. These are serere26/19, 6A, 2A and 3A. Some have bristles.

Land preparation.

Prepare land early to give soil enough time to settle and form a firm seedbed.

Requires a fine seedbed to give a good seed-soil contact.

Field operations.

Planting.

Commonly done by broadcasting followed by shallow cultivation before onset of rains. For row planting, spacing is 60X15CM.

Weeding.

It is resistant to weeds especially after tillering occurs where it is able to suppress weeds, prior to that, the seedbed should be kept weed free.

Fertiliser application.

SA at a rate of 200Kg/Ha is applied when the crop is at 30CM high.

Pest and disease control.

Pests.

Main field pest are Quelea Quelea, weaver birds and bishop's birds.

Attack grains at milky stage onwards.

Control.

Fixing bird scaring devices in the field.

Diseases

Downy mildew.

Caused by a fungus (*Sclerospora graminicola).*

Characterised by long, whitish lines on the leaves.

Control.

- Crop rotation.
- Destroying crop remains after harvesting.

Rust.

Fungal disease caused by (*Puccina penniseti).*

Characterised by pustules that develop on the leaves.

Control.

- Use of resistant varieties.

Ergot.

Fungal disease caused by (*Clavicepts microcephala).* Not serious in bulrush millet.

Affected heads becomes sticky.

Control.

- Use of certified seeds.
- Crop rotation.
- Destruction of infected crop residue.

Harvesting.

Done by cutting the heads with a knife or sickle when dry. Threshing is done by beating the dry heads on the ground.

Yields 1000Kg/Ha.

SORGHUM. (*Sorghum vulgare).*

Fairly tolerant to drought.

Resistant to waterlogging. Yields reasonably well on infertile soils. Can be ratooned.

Utilisation: grains ground into flour or used for brewing. Young crops used as fodder for feeding livestock but should be wilted first.

Ecological requirements.

Features that makes sorghum drought resistant.

- Has well developed rooting system.
- Has ability to roll up its leaves during hot weather.

- Rainfall requirements is 420mm-630mm per annum thus grows well at altitude below 1500M above sea level.
- At higher altitude poor yields are obtained and the crop is attacked by pests such as shoot fly and downy mildew disease.
- Requires fairly fertile and well drained soils.

Varieties.

Characterised by seed colour and taste.

- White in colour. Palatable.
- Brown/red. Bitter.

Improved varieties.

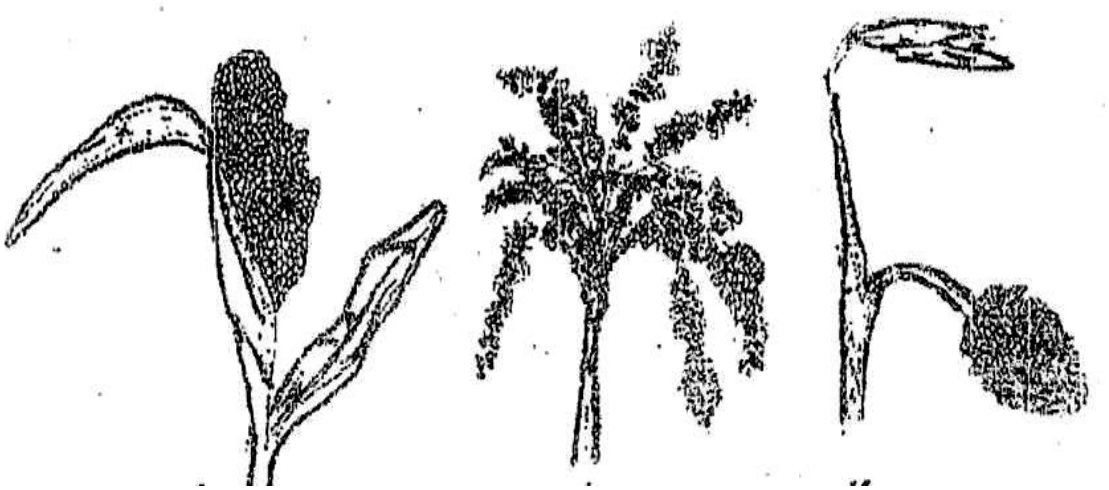
a) Dobbs.

Suitable for areas around the shores of Lake Victoria. Seeds are brown and it matures in four months.

b) Serena.

Crossbreed of dobbs and a variety from Swaziland.
Has brown seeds and matures in 3 ½ months.

Varieties with compact panicles and goose neck have some resistance to bird damage.



Compact panicle. **Open panicle.** **Goose necked.**

Selection and preparation of planting materials.

Seeds are prepared by threshing the dry heads, winnowing and seed-dressing.

Field operations.

Planting.

Done by broadcasting seeds on firmly prepared seedbed.

Sown together with maize and beans.

As a pure stand, the spacing is 60X15CM.

Fertiliser application.

Not commonly used. It responds well to farm yard manure most soils.

PESTS AND DISEASE CONTROL.

Pests.

Birds.

Major pest. The serious pest is the Sudan dioch (*Quelea Quelea aethiopica).*

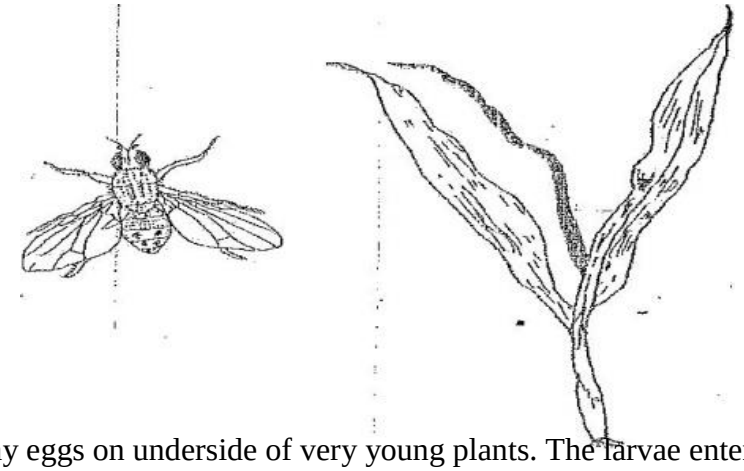
Other birds include: weaver bird, strarling and bishop's bird.

Sorghum however has natural qualities such as bitter tasting coats in coloured grains that keeps birds away. Similarly the goose necked and compact panicle sorghum varieties are resistant to birds attack.

Control.

Using flame throwers, explosives or poison sprays in their breeding colonies.

Sorghum shoot fly. (*Antherigona varia).*



Adult fly lay eggs on underside of very young plants. The larvae enters the tunnel and moves down to feed on the young stem killing the shoots. Several tillers then appear and may also be attacked.

Control.

- Early planting.
- Closed season.
- Use of appropriate insecticides.

Stem borers. (*Busseola fusca).*

There are three main species of stem borers attacking sorghum.

a) Common maize stalk borer. (*Busseola fusca).*

It is easy to control as it feeds in the tunnels before moving down to feed on developing tissues.

b) *Chilo zonellus.*

Difficult to control as it does not have distinct population peaks.

c) *Sesamia calamistis.*

Bore holes straight into the centre of the stem.

Control measures.

- Use of appropriate insecticides.
- Proper disposal of crop remains after harvesting.

Diseases.

Attacked by leaf and inflorescence diseases.

a) Leaf diseases.

- Leaf blight. (*Helminthosporium turcicum).*
- Anthracnose. (*Colletotrichium graminicola).*
- Sooty stripe. (*Ramulispora sorghi).*

Control.

Using resistant varieties.

b) Diseases of inflorescence.

- Loose smut. (*Sphacelotheca cruenta).*
- Head smut. (*Sphacelotheca reiliana).*

Control.

Seed dressing.

Harvesting and marketing.

Takes three months. Heads are cut using a sharp knife, sun dried, threshed, winnowed and stored.

Yields' 500-1500kg/Ha. Can be ratooned for one to two seasons. Marketed through NCPB or purchased directly from farmers.

BEANS. (*Phaseolus vulgaris)*.

Grown for the dry seed and for green pods (French beans). Some are determinate, bush type (non- spreading) and others indeterminate (spreading type).

Ecological requirements.

Do best in well drained loam soils rich in organic matter.

Requires well drained soils (does not tolerate waterlogged soils.).

Requires moist soils throughout the growing period. Requires moderate rainfall. Heavy rainfall is destructive at flowering stage. Requires dry weather during harvesting as rain causes rotting and sprouting of beans. French beans are produced under irrigation.

Varieties.

Dry beans varieties.

- Rose coco (GLP2).
- Mwezi moja (GLP1004).
- Canadian wonder (GLP24)
- Wairimu.
- Mexican 142(canning variety drought tolerant and resistant to rust.)

French beans varieties.

- Monel.
- Mater piece.
- Amy.
- Samatha.

Selection and preparation of planting materials.

Seeds should be dried before they are planted. Seed selection should be done to discard the damaged and wrinkled seeds.

Should be dressed to control soil borne pests and inoculated with the right strain of Rhizobium.

Land preparation.

Done early to kill all perennial weeds. Beans requires a medium tilth.

Field operations.

Planting.

Planted at onset of rains but during long rains should be delayed to avoid rotting of the crop before harvesting.

Planting at spacing of 30-45X15Cm 2-3 seeds per hole.

Dap at a rate of 200kgs/ha along furrows before planting and manure well rotten and mixed well with soil. Seed rate is 50-60kg/ha.

Weeding.

Filed is kept weed free by shallow weeding. Done before flowering to avoid knocking down flowers. Weed when soil is dry to prevent disease spread.

Irrigation.

Beans for green pods are grown under irrigation and require 50mm/week of water.

PEST AND DISEASE CONTROL.

Pests.

Bean aphid, bean bruchids, and bean fly and American boll worm.

Control.

- Using appropriate insecticides.

Diseases.

Include: halo blight, anthracnose, bean rust and angular leaf spot.

a) **Bacterial (Halo) blight.**

Caused by *Pseudomonas phaseolicola*.

Causes brown water-soaked lesions on pods. The spot is surrounded by a broad yellow band “halo”.

It is seed borne and spread by rain.

Control.

- Planting healthy seeds.
- Rogueing.
- Crop rotation.
- Spraying with copper oxychloride.

b) Anthracnose.

Fungal disease caused by *Colletrichium lindemuthianum.*

Causes brown lesions on pods and stems and brown spots on leaves.

Control.

- Use of clean seeds.
- Dressing seeds with captan.
- Destruction of infected crop residues.
- In wet weather, spraying weekly with copper fungicides/ Mancozeb.

c) Bean rust.

Fungal disease caused by *Uromyces appendiculatus.*

Causes pustules of red-brown powdery spores on stems and leaves.

Control.

- Eliminate volunteer bean plants.
- Rotate bean with non-host crops.
- Disinfect poles in production of staked beans.
- Ovoid over application of nitrogen and ensure adequate potassium application.

Harvesting.

Beans for seeds are harvested by harvested uprooting the dry plants. Uprooting is done when weather is cool to minimise amount of pod shattering.

The beans are then spread on mats or sacks to dry before threshing.

They are threshed by beating with sticks and then winnowed.

Sorting is then done to remove damaged seeds.

French beans. Harvesting of pods starts about nine weeks after planting and continues for two months. Picking should be in dry weather and pods sorted according to size.

Pods should be packed immediately after picking to avoid shrivelling and taken to airport (for export) within 12 hours of harvesting.

Yields 4-5tonnes/ha.

RICE. (*Oryza sativa).*

Cereal crop grown under paddy irrigation.

Land preparation.

The fields are levelled and bunds constructed around them for controlling water.

Rotavators are used in the flooded fields before transplanting or a jembe is used.

Water control.

Level of water in the field is increased from a very low level of 5cm at planting time gradually to a height of 15cm by time when seedlings are fully grown.

Water is allowed to flow slowly through the filed. If flow of water is not possible then old water should be drained and fresh water added every 2-3 weeks.

Fertiliser application.

SA is applied at a rate of 25kg for each nursery unit. 18.5MX18.5M before sowing.

DSP is broadcasted in the field at a rate of 120kg/ha before planting.

Weed control.

Weeds are easily controlled by the flooding. Those not controlled should be uprooted or used of an herbicide such as Butachor.

HARVESTING OF INDUSTRIAL CROPS.

Industrial crops.

Crops that must be processed first before use.

HARVESTING OF COTTON.

Picked manually. Grading starts at picking. The seed cotton is sorted into two grades.

- **AR (Safi).** First grade free from insect damage and foreign materials and is clean white.
- **BR (fifi).**

Carry two containers for each grades.

Precautions during harvesting.

- Care should be taken to ensure no foreign materials e.g. small twigs are mixed with seed cotton.
- Avoid picking when it is wet.
- Do not use sisal bags as their fibres may mix with the seed cotton creating problems during ginning.

HARVESTING OF PYRETHRUM.

Crop remain in production for three years.

Method and procedure of harvesting.

Pick only those having horizontal petals (ray flowers) with 2-3 rows of disc florets open.

Picking intervals 14-21 days but depend on the following.

- Weather conditions.
- Clone used.
- Soil conditions.

Pick by twisting stem so that no stem is attached.

Precautions during harvesting.

- Picked flowers should be put into an open woven basket to allow proper ventilation.
- Avoid using tins or polythene bags that causes fermentation of flowers.
- Avoid picking wet flowers as they may heat up and ferment before they are dry.
- Do not compact flowers in the baskets to discourage heating and fermentation that lowers pyrethrin content.

HARVESTING OF SUGARCANE.

Takes 18-20 months while a ratoon crop takes 16 months (western).

In coast first crop 14months and a ratoon crop 12 months.

Method and procedure of harvesting.

Before harvesting, samples should be taken for quality testing in the factory. Should have uniform distribution of sugar.

Crop should be cut at ground level to prevent loss of yield and ensure proper establishment of the ratoon. The green tops are removed to avoid some growth substances from flowing back thus lowering quality of sugar.

Harvesting is done using a cane harvesting machete.

Precautions in harvesting.

- Some prefer burning the sugar-cane fields before harvesting to help remove most of the leaves and chase away snakes.
- Canes should be delivered to the factory within 24 hours to ensure quality is maintained.

HARVESTING COFFEE.

Takes 3-5 years from planting to flowering. Takes 8-9 months from flowering to when berries are ready for picking.

Method and procedure of harvesting.

Picking is done by hand.

To have good quality cherry, only the red berries should be picked.

They are then spread on sisal bags to sort out any unripe, diseased, over-ripe and dry berries.

Green berries, dry and undersize are dried to form ‘buni’ which are sold separately at the end of the harvest season.

Precautions in harvesting.

Berries should be delivered on time to the factory on the day they are harvested to maintain quality.

HARVESTING OF TEA.

Pegged tea takes 2 years to harvesting while formative tea 4 years to harvesting.

Method and procedure.

Two leaves and a bud are plucked. The lower leaves have lower caffeine content. Plucking sticks helps the pluckers maintain the plucking table. Plucked tea is put into woven baskets that allow free movement of air to prevent tea from fermenting before it is delivered to the factory.

Precautions in harvesting.

- Leaves should not be compressed in the baskets to prevent heating up and turn brown lowering quality.
- Plucked tea should be kept in cool and shaded place during plucking and while awaiting transport to the factory.
- Should be delivered to the factory on the same day it is harvested.

CHAPTER NINE.

FORAGE CROPS.

- Pastures are harvested directly by livestock through grazing.
- Fodder are harvested by cutting and feeding to livestock.

PASTURES.

Pasture classification.

Pastures can be classified in three main ways.

- According to the pasture stand.
- According to pasture establishment.
- According to the ecological zones/altitudes.

Classification according to pasture stand.

- Pure stand.
- Mixed stand.

Pure stand pasture has only one type of grass or a mixture of different grasses.

Mixed stand is where grasses and legumes are grown together.

Classification on the basis of establishment.

- Natural pastures.
- Artificial pastures.

Natural pastures grasses and legumes grow naturally and extensively. Are mainly mixed stand pastures.

Artificial pastures (leys) are grasses and legumes planted by man purposely for livestock feeds.

Classification on the basis of establishment.

- High altitude grasses pastures and legumes.
- Medium altitude pastures.
- Low altitude pastures.

High altitude pastures.

Pastures found at high altitude of2500M above the sea level. Suitable for dairy and sheep farming.

Examples.

Grasses.

Common name	**botanical name.**
1. Kikuyu grass.	(*Pennisetum clandestinum).*
2. Nandi Setaria.	(*Setaria sphacelata).*
3. Molasses grass.	(*Melinis minutiflora).*
4. Giant Setaria.	(*Setaria splendida).*
5. Rhode grass.	(*Chloris gayana).*

Legumes.

Common name	**botanical name.**
1. Kenya white clovers.	(*Trifolium repers).*
2. Louisiana white clovers.	(*Trifolium semipilosum).*
3. Subterranean clover.	(*Trifolium subtervianeum.).*
4. Lucerne.	(*Medicago sativa).*

Medium altitude pastures.

Pastures found at an altitude between 1500-2500M above the sea level. Favours beef, goats, sheep and dairy farming.

Examples.

Grasses.

Common name	**botanical name.**
1. Rhode grass.	*(Chloris gayana c.v,Mbarara)*
2. Nandi Setaria.	(*Setaria sphacelata c.v.Nandi)*
3. Star grass.	(*Cynodon dactylon).*
4. Makueni guinea.	(*Panicum maximum c.v.Makueni).*
5. Congo signal.	(*Branchiaria yuziziensis).*
6. Malava guinea.	(*Panicum coloratum).*
7. Giant Setaria.	(*Setaria splendida).*
8. Guatemala grass.	(*Trypsacum laxum).*

Legumes.

Common name	**botanical name.**
1. Lucerne.	(*Medicago sativa).*
2. Silver leaf Desmodium.	(*Desmodium uncinatum).*
3. Green leaf Desmodium.	(*Desmodium intortum).*
4. Siratro.	(*Macroptilium atropurpureum).*
5. Stylo.	(*Stylosanthes guiyanensis).*

Low altitude pastures.

Found in marginal areas below 1500M above the sea level. Characterised by natural pastures

Examples.

Grasses.

Common name	**botanical name.**
1. .African fox tail.	(*Cenchrus ciliaris).*
2. Maasai love grass.	(*Eragrostis superba).*
3. Likoni guinea.	(*Panicum maximum c.v.Likoni).*
4. Makarikari grass.	(*Panicum coloratum).*
5. Red oat grass.	(*Themada triandra).*
6. Hyparrhenia (thatch grass).	(*Hyparrhenia rufa).*
7. Giant star grass.	(*Cynodon plectostadyus).*
8. Bothriochloa.	(*Bothriochloa insulpta).*
9. Para grass.	(*Branchiaria mutica).*
10. Andropogon.	(*Andropogon spp).*
11. Cymbopogon.	(*Cymbopogon afranandus).*
12. Digitaria.	(*Digitaria decumbeus).*

Legumes.

Common name	**botanical name.**
1. Stylo.	(*Stycosanthes searbra).*
2. Glycine.	(*Glycine weghtii).*
3. Centro.	(*Cenrosema pubescens).*

Other pasture crops,

Weed grasses.

Common name	**botanical name.**
1. Couch grass.	(*Digitaria scalarum).*
2. Nut sedges.	(*Cyprus spp).*
3. Sporobolus.	*(Sporobolus spp).*

Fodder shrubs.

Common name	**botanical name.**
1. Leucaenia.	(*Leucaenia leucocephala).*
2. Atriples.	(*Atriples spp).*

Pasture establishment.

Pastures can be established by use of:

- Seeds.
- Rhizomes.
- Splits.

a) Selection of planting materials.

Should be:

- Adapted to the prevailing environmental conditions.
- Fast growing in order to give a good ground cover which helps to control soil erosion.
- A variety able to give high herbage yield per unit area.

b) Land preparation.

Land should be ploughed and harrowed to a fine tilth. All perennial weeds should be removed at this stage.

c) Planting materials.

Most are established from seeds. Permanent pastures are established vegetatively due to seed production problem.

d) Seed rates.

Pasture grasses require a seed rate of 1.5 to 2.0kgs /ha of PGS (pure germinating seeds)

e) Fertilizer application at planting time.

- Requires phosphorus for proper root development and establishment.
- SSP (20% P_2O_5 and 12%S) at the rate of 200kg/ha for grasses and legumes mixtures because of its sulphur content.
- For pure grasses a compound fertiliser such as NPK 20:20:0 or 23:23:0 ensures rapid establishment due to presence of starter nitrogen.

f) Legume seed inoculation.

Addition of effective Rhizobia to leguminous seeds before planting to promote nitrogen fixation.

Involves coating of seeds with the mixture (source of nutrient).

Some Rhizobia are naturally found in soil at pH of5.5-8.5, with adequate calcium phosphorus and potassium and rainfall.

Crop.	**Rhizobium species.**
Lucerne.	*Rhizobium melioti.*
Clovers.	*Rhizobium trifoli.*
Beans.	*Rhizobium phaseoli.*

g) Sowing.

Methods of sowing.

- Direct sowing.
- Under sowing.
- Over sowing.

a) Direct sowing.

Establishment of pasture crops in a clean seedbed where no other crops are growing.

Seeds are mixed with fertiliser and broadcasted and then slightly covered 3mm deep.

b) Under sowing.

Establishment of a pasture under a cover crop usually maize. Maize is planted, weeding is done 2-3 weeks after onset of rains then pasture seeds are broadcasted. Maize is harvested early to expose the pasture seedlings to sunlight.

c) Over sowing.

Establishment of a pasture in an existing grass pasture.

The growth of the existing pastures is suppressed by:

- Burning.
- Slashing.
- Hard/heavy grazing with light soil disturbance.

SSP at a rate of 200kg-400kg/ha is applied. Pasture grass is then kept short until the legume pasture is well established.

MANAGEMENT OF PASTURES.

Weeding.

Effects of weed on pastures.

- Weeds reduce life span of the pastures.
- Weeds compete with footage crops for nutrients, sunlight and moisture.
- Weeds reduce quality and herbage yield.

- Some may result in livestock poisoning such as *Datura stramonium.*
- Weeds interferes with forage fertilisation.

Effective weed control measures.

- **Timely land preparation.**

Ensures clean seedbed with less subsequent weed problem.

- **Slashing.**

Eliminates broad leaved weeds before flowering stage preventing formation of seeds.

Application of selective herbicides.

Such as 2,4-D against broad leaved weeds on pure stand pastures.

- **Uprooting of weeds.**

Effective where weeds are scattered.

Top dressing.

Reasons for top dressing.

- To add (replenish) soil nutrients and ensure proper nutrient balance.
- To improve the nutritive value of the crop.
- To increase herbage yield.
- To correct or amend both physical and chemical properties such as oils structure and water holding capacity.
- To enable the soil microorganisms to break down organic residues into available nutrients.

Rate of application should be related to the nutrients uptake by the forage crop.

- **Topping.**

Removal of the stemmy fibrous material left over after a period of pastuer grazing.

This stimulates fresh growth.

Done through slashing, mowing and burning.

- **Re-seeding/gapping.**

Done when the grass or legume is partially denuded to an extent of refilling the gaps.

- **Controlled grazing.**

Some pasture crops are seriously affected by heavy grazing. Grazing should be controlled through paddocking, tethering and strip grazing.

Pest control.

The most serious pest is mole. They make underground tunnels destroying roots of pasture crops hence killing them.

Control.

- Trapping.
- Use of rodenticides.
- Biological control such as cats.

PASTURE UTILISATION.

Forage quality.

There is gradual decline in quality components and digestibility with age.

Digestibility decline because of the increase in crude fibre content.

Frequency of defoliation.

Defoliation.

Grazing in pastures and cutting for feed in fodder crops.

Intensity of defoliation.

Refers to how often forage stand is grazed or cut for feed.

Effects of very early defoliation. (Less than four weeks).

- The forage has very high moisture content of about 90%.
- It has very high protein content on weight basis.
- Has very low DM content hence low DM yield.
- Has very low crude protein yield.
- It has high DM digestibility but low digestible nutrients.
- Frequent early defoliation leads to a gradual weakening of the stand, followed by empty patches and weed invasion.

Effects of late defoliation. (More than ten weeks).

- It has high DM hence high DM yield.
- It has high cellulose content hence it is woody and fibrous.
- It has high lignin, cutin, tannin and silica content that are indigestible.
- Has low crude protein content.
- Has low leaf: stem ratio.
- Has low DM digestibility.

Reasons why paddocking is necessary.

- To control grazing and ensure sufficient re-growth before grazing is resumed.
- To ensure better forage utilisation and less wastage through trampling, fouling and selective grazing.
- To facilitate conservation of excess pastures in form of hay or standing forage.
- To maintain a favourable grass-legume balance in case of mixed stand.

Carrying capacity and stocking rate.

Carrying capacity.

Ability of forage stand to maintain a particular number of livestock units per unit area.

Stocking rate.

Number of animals (LU) maintained per unit area of land.

Ways of increasing the carrying capacity.

Intensive management practices such as:

- Irrigation.
- Use of fertilizers/ manure.
- Use of supplementary roughages.

A dairy animal consumes 2.5kg dry matter for every 100kg body weight per day, the amount consumed by a jersey weighing 400kg live weight would be:

2.5X450/1000 X365/1000= 3.65 tonnes DM.

Grass.	**DM yield T/ha/year**	**Carrying capacity (L.U/ha.**
Napier.	25-30.	5-7.0
Rhodes (Mbarara).	10.9-15.2.	2.5-3.5.
Nandi Setaria.	11.4-13.9	2.5-3.0.
Makueni grass.	9.9-15.9.	2.5-3.5.
Star grass.	5.3-9.1.	1.3-2.0.
Kikuyu grass.	4.3-14.3.	1.0-3.0

Effects of over stocking.

- Insufficient regrowth period for the forage hence has effects similar to those of early defoliation.
- Overgrazing and loss of soil cover leading to soil erosion.
- Invasion of undesirable plant species especially weeds and shrubs.

Intensity of defoliation.

This is the preparation of herbage removed through grazing and that of the residual forage.

In fodder crops it refers to the ratio of the forage cut to what is left.

Pastures should be grazed until 70% of the aerial herbage is eaten up or 5cm stubble for short grasses and 10-15cm for taller grasses.

GRAZING SYSTEMS.

- Rotational grazing systems.
- Continuous grazing system.

1) Rotational grazing.

Refers to allowing livestock to feed on a part of pasture for a period down to a certain level before they are moved to the next.

Advantages of rotational grazing.

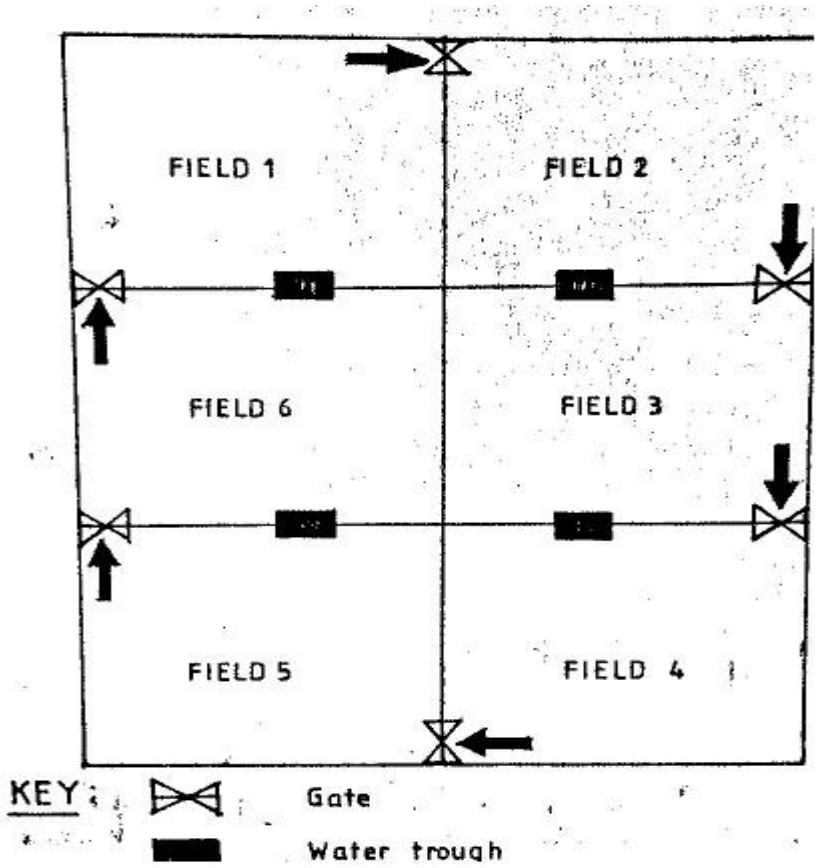
1. Livestock make maximum use of pastures.
2. Reduces the build-up of pest and diseases.
3. Animal waste is distributed evenly in all fields or paddocks.
4. Pasture area is given time to regrow before it is grazed on again.
5. Excess pasture can be harvested for conservation.
6. It is possible to apply fertiliser in portion of the pastures which are not in use. Re-seeding and weeding can also be done.

Methods used to achieve rotational grazing.

a) Paddocking.

Paddock. Fenced portion of a pasture in which animals are restricted for grazing.

Water troughs are placed between two paddocks so that animals can drink water from either paddock.



b) Strip grazing.

Done by allowing livestock to graze on restricted portions of pasture at a time then moving them to the next. Done very high quality pastures.

It is expensive because it involves establishing an electric fences.

c) Tethering.

Involves tying an animal to a post with a rope such that it feed within a restricted area.

2) **Continuous grazing.**

Pastures are not allowed any resting period.

It may result in overgrazing if the stocking rate is not controlled.

3) Zero grazing. (stall feeding)

Practice of rearing animals in a permanent feeding enclosure known as stall.

Advantages.

1) There is quick accumulation of manure.
2) Animals make use of feeds without wastage.
3) Animals produce high yields due to less wastage of energy.
4) It is easy to control diseases and parasites.
5) Requires little land.
6) Allows higher stocking rate.

Disadvantages.

1) High initial capital is required.
2) High management skills are needed.
3) Need a lot of labour.
4) Diseases can be easily spread.

FODDER CROPS.

Forage crops which are grown, allowed to mature, then cut and given to livestock as feed.

Livestock do not graze directly on them as they easily degenerate.

1) NAPIER GRASS. (*Pennisetum purpureum).*

Varieties.

- French Cameroon.
- Bana grass.

French Cameroon.

Has thin stems and is not very hairy.

Bana grass.

Hairy type with thick stems.

ECOLOGICAL REQUIREMENTS.

a) **Soils.**

Does well in a variety of soils within high and medium altitude zones.

b) **Rainfall.**

Requires a minimum of 750mm of rainfall per year. Should be well distributed throughout the year.

c) **Altitude and temperatures.**

Does well in temperatures ranging from 24 degree to 29 degrees Celsius. Does well at an altitude of 2100M above the seal level.

ESTABLISHMENT AND MANAGEMENT.

a) **Land preparation.**

Land is prepared early during the dry season. Vegetation is cleared and all stumps are removed.

Primary cultivation is then carried out removing all perennial weeds. The land is then harrowed to produce a medium tilth.

Furrows are made at a spacing of 90-100cm or holes at a spacing of 90-100cm between rows and 50cm between plants.

7-10 tonnes of well decomposed manure is then applied in the soil.

b) **Planting.**

The materials should come from healthy and mature mother plants.

Stem cuttings or splits are used.

Stem cuttings should have 2-3 nodes. Planting should be done at the onset of the rains.

Stem cuttings should be placed in the furrows or holes in a slanting manner. Two nodes should be covered underground and one node should remain above the ground.

c) Fertiliser application.

Top dressing with nitrogen and potassium fertiliser is done about 6-8 weeks after planting. (After first weeding).

Top dressing should be don thereafter after every harvesting to increase the rate of stump regeneration.

d) Weed control.

- Weeds lower the yields of nappier grass as a result of competition for nutrients.
- They also lower the rate of establishment.
- Thorn apple and Sodom apple e.tc are poisonous to the livestock.

Controlled through cultivation, slashing, uprooting and use of herbicides such as 2.4-D.

e) Defoliation.

Refers to the ratio of forage cut to what is left.

French Cameroon matures in about 3 months (first harvesting.).

Should be cut every 6-8 weeks depending on moisture availability. Cut at 1.2-1.5M high.

Bana grass grows up to 12 months without flowering thus is suitable for use as standing forage.

f) Utilisation.

Should be cut at 1.2-1.5M high when proportion of leaves is higher than that of stems.

Stems should be cut 2.5-5.0cm above the soul surface to facilitate faster re-growth.

Use a sharp panga to avoid destroying the stumps.

Excess nappier grass should be conserved as silage. It may also be used as mulching materials.

2) GUATEMALA. (*Trypsacum laxum).*

It is a tall, hardy broad-leaved grass.

ECOLOGICAL REQUIREMENTS.

Altitude.

Does well in high altitude. It is affected by extreme coldness in altitude above 2000M above the sea level.

Rainfall.

Requires slightly high amount of rains ranging above 900mm per annum and should be well distributed throughout the year.

ESTABLISHMENT AND MANAGEMENT.

a) Land preparation.

Land is prepared early before onset of rain. Land is ploughed and then harrowed to a medium tilth removing all perennial weeds.

b) Planting.

Established from stem cuttings or from splits. Seeds can also be used but it takes longer to reach cutting stage. Furrows are made at a spacing of one metre apart and the cuttings or splits are planted 0.5m apart. Planting should be done at onset of rains or where possible irrigation can be done after planting.

c) Fertiliser application.

Organic manure is incorporated into the soil during land preparation. During planting NPK 20:20:0 is applied at a rate 150kg/ha. Top dressing with Nitrogen fertiliser is done when the grass is 6-8weeks old. Subsequent top dressing should be done after each harvesting and weeding to increase herbage production.

d) Weed control.

Can resist weeds but the filed should be kept weed free especially before it establish well. Done by uprooting, cultivation, slashing or by use of selective herbicides.

e) Defoliation.

Takes a long time to flower thus can be harvested when it is over 8-12 weeks old.

f) Utilisation.

It is chopped and fed to livestock as green fodder. Suitable for stall feeding.

Production per unit area.

Yields 12 tonnes per ha of DM per year. Can support 2-3 cows.

3) SORGHUM. (*Sorghum alum).*

There are two main varieties.

- Columbus grass. (*Sorghum alum)*
- Sudan grass. (*Sorghum Sudanese).*

ECOLOGICAL REQUIREMENTS.

Rainfall.

Does well in areas with rainfall above 650mm per annum. Should be well distributed throughout the year.

Altitude.

It grows best in altitude below 2100M above the sea level.

Soils.

Grows in a wide range of soils as long as the rainfall is enough and well distributed.

ESTABLISHMENT AND MANAGEMENT.

a) Land preparation.

Land is done early before the onset of rains during which all perennial weeds are removed. The field is ploughed and harrowed to a fine tilth.

b) Planting.

Established by use of seeds. The seeds are either drilled or broadcasted. NPK 20:20:0 is applied at the rate of 200kg/ha for proper root growth and development.

c) Fertiliser application.

Top dressing using CAN or ASN at rate of 125kg/ha depending on soil pH.

d) Weeding.

Keep the field weed free especially during the establishment stage. Weed control is done by hand cultivation, slashing or by use of selective herbicides.

e) Utilisation.

Columbus grass lasts in the field for 18 months during which it is harvested severally. Columbus grass should be left to dry for two days to avoid **prussic and hydrocyanic acid** poisoning found in wet grass. In case of this poisoning, the animal should be dosed with **sodium thiosulphate.**

Production per unit area.

Yields over 20 tonnes/ha of DM per annum.

4) KALES. (*Brassica spp).*

Ecological requirement.

Kales require high altitude with annual rainfall exceeding 100mm. grow well in loam and clay soils with reasonable.

ESTABLISHMENT AND MANAGEMENT.

They are established through seeds. Seeds are planted in nurseries six weeks before the rains. Land is cleared, ploughed and harrowed to a medium tilth. Holes are dug at a spacing of 1.0MX0.3M. Transplanting is done at onset of rains.DSP is applied t the rate of 150kg/ha during transplanting.

Utilisation.

Leafy stems are cut, chopped and fed to livestock.

Should be fed to milking cows together with dry roughages because they are very succulent.

Should be given to milking cows after milking to avoid tainting the milk.

Production by unit area.

Produce 35-50tones/ha per year.

5) EDIBLE CANNA. (*Canna edulis).*

Fodder crop with broad shinny leaves.

Ecological requirements.

Requires high rainfall areas at an altitude of 15500-2000M above the sea level.

Establishment and management.

The land is cleared, ploughed and then harrowed. Holes are dug at a spacing of 1MX1M. Farmyard manure is mixed thoroughly in the holes before planting. Underground rhizomes are planted at the onset of rains. Early weeding is done. Cultivation, uprooting, slashing and by use of suitable herbicides. Top dressing is done four weeks after transplanting at the rate of 100kg nitrogen/ha. CAN is used for acidic soils while ASN for alkaline soils.

Utilisation.

Cut and feed to livestock when fresh.

Production per unit area.

100 tonnes DM/ha/ year.

6) MARIGOLDS/SUGAR BEETS. (*Beta vulgaris).*

Root fodder crop.

Ecological requirements.

Do well at high altitude areas with annual rainfall exceeding 100mm. grows well in well drained soils.

Establishment and management.

Established through seed. Seeds are planted in nurseries 6 weeks before onset of rainfall.

Land is cleared, ploughed and then harrowed to a medium tilth. Holes are dug at a spacing of 1MX0.3M. Transplanting is done at onset of rain.DSP at a rate of 150kg/ha is applied at transplanting. Top dressing is done using CAN or ASN depending on soil pH at a rate of 100kg nitrogen/ha.

Utilisation.

Used for feeding livestock during season at the rate of 22-27kg/cow/day. They are chopped into small pieces to prevent chocking. Should be wilted before being fed to livestock to prevent poisoning by oxalic content.

Production per unit area.

Produces between 30-40kg/ha under good management.

7) KENYA WHITE CLOVER. (*Trifolium semipilosum)*

Low forage legume which grows to a height of 30cm. has slender spreading stems which produce roots and underground rhizomes.

Ecological requirements.

Grows in high altitude areas 2500-3000M above the sea level.in lower region it is restricted to the moist regions. Grows in a wide range of soils, preferably well drained with a pH of 5.5.

ESTABLISHMENT AND MANAGEMENT.

Has good seedling qualities and establishment from seed is easy where rainfall is sufficient.seeds are mixed with a Nitro-culture and broadcasted in moist soils. Established clover can do well over sown with other pastures.

Over sowing.

Clovers can be over sown with Nandi Setaria and Rhodes grass. It should be inoculated with the correct bacteria before sowing.

Inoculation.

Addition of effective bacteria to the clover seeds before planting to promote the Nitrogen fixation especially when grown in mixed stand.

Fertiliser application.

Applicable to already existing grass pasture. Application of phosphatic fertiliser is advisable.

Utilisation.

Do not withstand heavy grazing. It is recommended to harvest the forage crop and take it to the animals.

8) LUCERNE. (*Medicago sativa).*

Leguminous crop also known as alfalfa. Common variety is the hunter river.

Ecological requirements.

Does well in high altitude areas. Requires well drained soils with a pH of 5.5 and above.

ESTABLISHMENT AND MANAGEMENT.

Established through seed. The land is cleared, ploughed and then harrowed to a fine tilth. The seeds are then inoculated. A sticker lime gypsum pelleting is necessary if the soil or fertiliser to be used is acidic. Peat-based rhizobia can be bought for this purpose. Seeds are broadcasted at the rate of 5-10kgs/ha. If seeds are drilled in rows, the spacing should be 30-50cm between the rows. DSP is applied at planting at a rate of 125kg/ha. Early weeding is done within the first month of establishment.

Utilisation.

Fed to livestock as hay since freshly harvested Lucerne can cause bloat. Fed in small quantities mixed with grass hay to lactating cows.

Production per unit area.

Produces 7-11 tonnes/ha with a CP of 17-20%.

9) DESMODIUM.

Climbing perennial herb with slender stems and trifoliate leaves. Fixes its own nitrogen thus does not need any nitrogenous fertiliser.

Varieties.

- Green leaf Desmodium. (*Desmodium intortum).*
- Silver leaf Desmodium. (*Desmodium unicinatum).*

Ecological requirements.

Does well in tropical climate conditions. Grows at an altitude of between 1200M-1800M above the sea level.

ESTABLISHMENT AND MANAGEMENT.

a) Land preparation.

Should be done before the rains and all perennial weeds removed. Should be ploughed and harrowed to a fine tilth.

b) Planting.

Established through seeds. The pods contains 1-3 seeds. When interplanted with nappier grass, the Desmodium seeds should be inoculated at planting. Seed rate is 1kg/ha.

c) Weed control.

Seedbed should be kept weed-free. Done through cultivation, uprooting or use of selective herbicides.

d) Fertiliser application.

Phosphatic fertiliser is applied at planting time at the rate of 125kg/ha. Does not need top dressing because it fixes its own nitrogen.

Utilisation.

Should not be cut too short. About 25cm ground cover should be left. Fodder may be cut and fed to livestock together with dry forage such as hay. Should be wilted before feeding the livestock.it is eaten less by sheep possibly because it is somewhat aromatic.

10) AGROFORESTRY TREES/BUSHES USED AS FODDER CROPS.

There are several species of shrubs or trees used as fodder crops. Include: *Leucaenia, Calliandra, Atriplex and Sesbania.*

Ecological requirements.

Leucaenia leucocephala is suited to warm high rainfall of up to 1500mm.

Calliandra calothyrsus is suited to high altitude areas.

ESTABLISHMENT AND MANAGEMENT.

Established through seeds. Seeds are first planted in a nursery bed. Seedlings are transplanted at the onset of rains. Spacing depends on the crop with which it is intercropped with. Seedlings are cared for through weeding, fertiliser application and protection from animals as the farmer tends to the main crop.

Utilisation.

The leaves and branches are cut and given to the animals directly. First cutting should not be done until they are 3-4M high. Shrubs are cut back at 0.5M above the ground once per year and at the begging of the rains. This encourages faster regeneration. Green seed pods produced are removed and fed to the animals. They have many other benefits.

FORAGE CONSERVATION.

Reasons for conserving forage.

- To distribute available forage for stock throughout the year.
- To provide feed for the dry season.
- To ensure better and full utilisation of available land.
- On a large-scale, conserved forage can be sold, for example baled hay.

METHODS OF CONSERVATION.

a) **Hay.**

Dried forage, mainly applicable to pasture grasses and legumes for example Rhodes grass or Desmodium.

b) **Silage.**

Anaerobically fermented forage mainly applicable to succulent fodder such as nappier grass, maize and sorghum.

c) **Standing forage.**

Growing forage set aside for dry season feed, applicable to both pastuer and fodder.

HAY MAKING.

Hay refers to forage which has been dehydrated (dried) to about 15-20% moisture content or less. Should be cut when about 50% of the plants have flowered. Cutting should be done when at least three days of continuous sunshine is expected.

Steps in making hay.

- The crop is cut when 50% of the pants have flowered.
- After cutting. The crop is spread out evenly on the ground to dry for 2-3 days depending on the environmental temperatures. Should be dried under controlled conditions in order to retain its nutritive value and the original crop colour.
- The hay is windrowed and the gathered or baled.
- The hay bales are then stored in a shed out of reach by rain water and sunshine.

Rapid drying is recommended to ensure high quality hay. Slow drying results in oxidation of soluble carbohydrates hence poor quality. Prolonged exposure to the sun results in the breakdown of chlorophyll and carotene. This is evident by bleaching of hay. Rain spoils hay and when occasional showers are expected, the forage may be dried on tripods.

Factors determining quality of hay.

- Forage species used.
- Stage of harvesting hence the leaf: stem ratio.
- Length of the drying period.
- Weather conditions during the drying process.
- Condition of the storage structure.

Sprinkling salt or molasses improves the palatability of hay.

SILAGE MAKING.

Fodder crop harvested while green and kept succulent by partial fermentation in a silo.

Silo is a structure used for fermenting.

The process of silage making is known as ensiling.

Advantages of silage making.

- More nutrients are preserved.
- It has few field losses.
- It is less dependent on weather conditions.
- Can be persevered for prolonged periods with minimum loss of nutrients.
- Once ensiled, there are no storage problems.
- Can be fed directly without liquid additives.

Disadvantages of silage making.

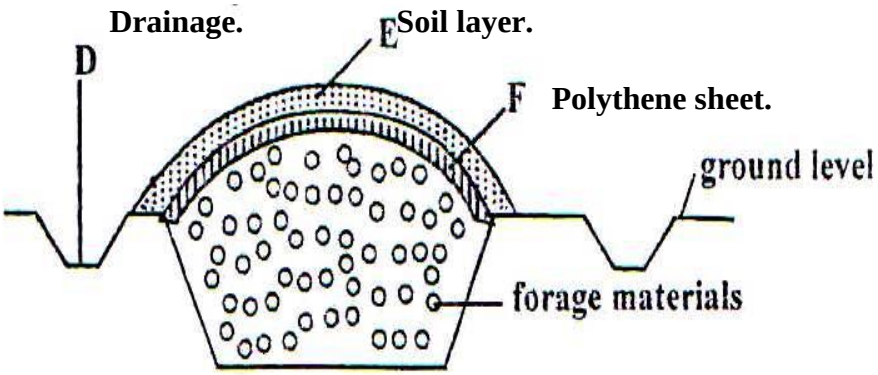
- It requires skills and great attention.
- It is a labour intensive exercise hence expensive.
- Most farmers cannot spare sufficient forage for ensiling at any one time.
- It is bulky to store and handle.
- Must be fed soon after removal.

TYPES OF SILOS.

Trench silo.

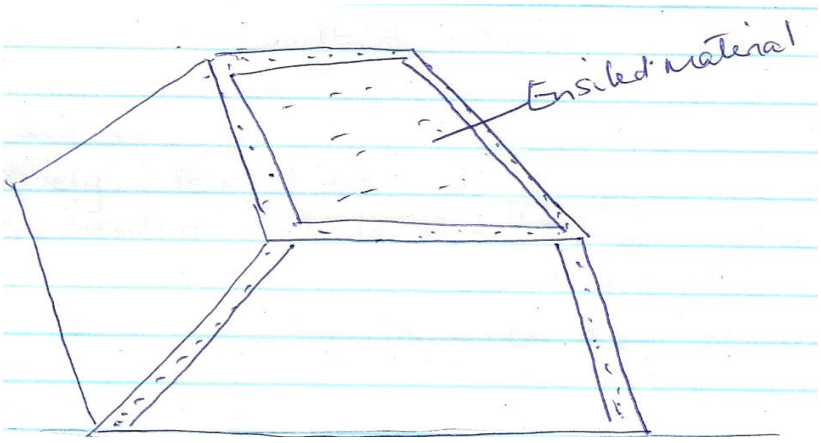
Rectangular excavation on a slightly sloping ground to ensure proper drainage.

Applicable to small scale farmers.



Clamp silo.

Constructed above the ground level in form of a trough with slanted sides for ease of compaction. The sides are made of timber walls with gaps between each pair of timber wall where soil is compacted. The floor is cemented.



Bunker/tower silo.

A bunker silo is made of concrete above the ground and has perpendicular walls suitable for mechanical ensiling.

A tower silo is a tall. Round, metallic structure for mechanical ensiling.

Steps followed in making silage.

1. The silo is prepared before harvesting the crop.
2. The crop is cut at the appropriate stage (8-10 weeks for re-growths) and wilted for 6-12 hours to about 65-75% moisture content.
3. The crop is chopped up and put into the silo, compacting it every 10-12cm layer.
4. The silo should be filled as rapidly as possible, preferably in less than two days. The ensiled materials should have a 'ridge' appearance when ensiling is complete.
5. Temperatures in the silo should be checked regularly during the ensiling process. If it is higher than 32.2, water should be added and compaction reduced. If it is below this, compaction should be increased and dry materials or molasses added.
6. The ensiled materials is covered with polythene sheet or a layer of dry grass to prevent it from water and air.
7. The silo is covered with a thick layer of soil.
8. A trench is dug all round the silo to drain off rain water.

Principles of preservation.

If aerobic respiration occurs during the ensiling process, it utilises the available soluble carbohydrates lowering quality. It must thus be minimised by compaction and rapid filling. Fermentation allows lactic acid bacteria (*Lactobacillus spp)* to increase rapidly within the first 4 days after silo sealing. Lactic acid bacteria acts on the readily available carbohydrates to produce lactic acid and limited amounts of: acetic, propionic, formic and succinic acid. Lactic acid concentration may reach 8-9% of DM reducing pH from 4 to 2. Low pH inhibits further bacterial growth and preserves the silage.

Use of additives.

Maize and other cereal crops such as wheat, oats and barley do not need additives. They are harvested at the soft dough stage as they have adequate supply of carbohydrates for proper fermentation. Others such as nappier grass have low amounts of carbohydrates thus need use of additives such as:

- Crushed grains 100kg/ton of silage.
- Molasses at 20-40kg/ton of silage.

Silage quality.

Poor silage compaction leads to low temperatures that results in excessive production of butyric acid instead of lactic acid.

Characteristics of good silage:

- Be from high quality forage cut at the proper stage of growth.
- Have a pH of 4.2 or below.
- Have 5-9% lactic acid.
- Be free of moulds and bad odours such as ammonia and butyric acid.
- Be greenish to yellow, not brown or black.
- Have a fine texture with no sliminess.

Silage losses.

a) **Surface spoilage.**

Up tom 20% loss due to exposure and contact with soil.

b) **Seepage losses.**

Extent of the loss increases with increase in herbage moisture and can be up to 50% in very young and succulent forage and the silo is not watertight.

c) **Gaseous losses.**

Extended respiration results in loss of carbohydrates in form of CO_2 .

Standing forage.

This is deferring cutting a portion of the forage for the dry season feed. However the herbage quality is low.

CHAPTER TEN.

LIVESTOCK HEALTH III.

Disease.

Any alteration in state of the body of an animal or its organs which interferes with proper performance of its functions.

Symptoms.

Visible signs of a disease.

Specific conditions that are observed.

- Pulse rate and respiration rate.
- Temperature.
- Body condition.
- Visible mucous membrane.
- Skin of the animal.
- Defecation.
- Urination.
- Feeding/appetite.
- Level of production.

Causes of diseases.

Pathogens.

- Protozoa.
- Bacteria.
- Virus.
- Fungi.

Non pathogenic causes.

- Poor nutrition.
- Physical injuries.
- Chemical poisoning.
- Parasitic infestation.

Predisposing factors.

Conditions inside or outside the body of an animal that lead to the animal contracting a disease or injury.

Include:

- Age of the animal.
- Sex of the animal.
- Colour of the animal.
- Change of climate/environment.
- Heredity.
- Overcrowding.
- Animal coming into contact with sick animals.

TERMS USED IN LIVESTOCK DISEASES.

1) **Incubation period.**

Duration between the time of infection and when the first symptoms shows up.

2) **Mortality.**

Likelihood of death occurring in a disease outbreak. Mortality rate is expressed as a percentage.

Mortality rate= (animals that die/animals affected) X100.

3) **Treatment.**

Application of physical and chemical means to an animal to help it recover from a disease or prevent it from contracting a disease.

Include:

- Preventive treatment.
- Curative treatment.

a) Curative treatment.

Tries to restores a sick animal back to health. Include:

- Good feeding.
- Provision of a clean environment.
- Neutralising the ill effects produced by the diseases.
- Inducing repair of damaged tissues.
- Reliving discomfort or injury to the animal.
- Preventing further spread of the disease.

b) Preventive treatment.

Involves administration of drugs to prevent occurrence of a disease. Include:

Vaccination.

Use of prophylactic drugs e.g. coccidiostats to prevent Coccidiosis.

4) Immunity.

Ability of an animal to resist the infection of a disease.

Types of immunity.

a) Natural immunity/inborn immunity.

Ability of an animal to maintain itself free from infection.

- Actively acquired natural immunity.
- Passively acquired nature immunity.

Inherited immunity is acquired from parents to offspring.

Actively acquired immunity depends upon a previous attack.

Passively acquired immunity is passed through the mother's blood, colostrum or milk.

b) Artificial immunity.

- Active artificial immunity.
- Passive artificial immunity.

Active artificial immunity. Obtained when an animal resists a disease causing organism. (Induces the body produce its own antibodies).

Passive artificial immunity. Anti-serum is injected to a healthy animal. (Dose not induce the animal to produce its own antibodies).

Vaccine.

Preparations of dead or altered disease causing organism.

Vaccines stimulate an animal's body to produce its own antibodies.

CLASSIFICATION OF LIVESTOCK DISEASES.

- Protozoan diseases.
- Bacterial diseases.
- Viral diseases.
- Nutritional diseases.

PROTOZOAN DISEASES.

1) East Coast Fever.
2) Anaplasmosis.
3) Coccidiosis.
4) Trypanosomiasis. (Nagana).

EAST COAST FEVER/THEIRELIOSIS.

Animals attacked.

Cattle.

Causal organism.

Protozoan. (*Theirelia parva).*

Transmitted by brown ear tick. (*Rhipicephalus appendiculatus).*

Incubation period is 15 days.

Symptoms of ECF.

i. Swollen lymph nodes especially around the base of ears, shoulders and stifle joints.
ii. Animal develops high temperatures (Fever).
iii. Profuse salivation, production of a lot of saliva.
iv. Lachrymation, production of a lot of tears from the eyes.
v. Difficulties in breathing especially at late stages of the disease due to fluid accumulation in lungs.
vi. Haemorrhages in the vulva and mouth.
vii. Coughing.
viii. Sight impairment.

Control and treatment.

i. Control of ticks through regular spraying, dipping or hand dressing using acaricides.
ii. The farm should be fenced to keep out strange animals and confine animals within.
iii. Treatment using appropriate drugs.

ANAPLASMOSIS/GALL SICKNESS.

Animals attacked.

- Cattle.
- Sheep.
- Goats.

Causal organism.

Anplasma marginale.

Transmitted by:

- Vector. Blue tick. (*Boophilus decoloratus).*
- Hypodermic needle.

Incubation period is 3-4 weeks.

Symptoms.

i. Constipation/hard dung.
ii. Paleness in gums, eyes and lips in later stages, an indication of anaemia.
iii. Fever.
iv. Milk flow into the udder ceases hence production goes down.

Control and treatment.

i. Control of ticks and biting insects such as mosquitoes and flies.
ii. Intramuscular injection of antibiotics and iron-giving injections.

COCCIDIOSIS.

Animals affected.

- Poultry.
- Young rabbits.
- Lambs.
- Calves.
- Kids.

Causal organism.

Coccidian of Eimeria species.

Coccidian infects the lining of alimentary canal.

Incubation period is 7 days for poultry and 4 weeks for cattle.

Symptoms.

i. Diarrhoea.
ii. Dysentery/blood in dung.
iii. Animal becomes emaciated.
iv. Birds have ruffled feathers.
v. Birds become dull with dropping wings.
vi. Sudden death in birds, rabbits and kids.

Control and treatment.

i. Isolation of infected animals in cattle. Use of portable calf pens is recommended,
ii. Use of coccidiostats drugs e.g., Amprol and Furexol for treatment and control.
iii. Avoid wet, filthy and unhygienic animal surrounding.
iv. Avoid common watering points for cattle from different farms.
v. Avoid overcrowding in poultry houses.

TRYPANOSOMIASIS/ NAGANA.

Animals affected.

- Cattle.
- Sheep.
- Goats.
- Horses.
- Pigs.

Causal organism.

- *Trypanosoma spp.*
- *Trypanosoma brucei brucei.*cattle.
- *Trypanosoma evansi*, horses.

Transmitted by a vector that is tstetste fly. Has an incubation of 1-3 weeks.

Symptoms.

i. High temperatures/fever. Intermittent body temperatures.
ii. The animal become dull.
iii. Loss of appetite/anorexia.
iv. General body weakness.
v. Swollen lymph nodes.
vi. Lachrymation that leads to blindness.
vii. Diarrhoea.
viii. Coat is rough sometimes without hair and may be cracked.
ix. Swelling of parts of the belly.
x. Milk production decreases,
xi. Loss of hair at tail end.
xii. Anaemia.
xiii. Abortion in pregnant females due to high temperatures.

Control and treatment.

i. Treatment with trypanocidal drugs.
ii. Effective control of tstetste flies.
iii. Confinement of game animals in game parks.

BACTERIAL DISEASES.

1. Mastitis.
2. Foot rot.
3. Contagious abortion/brucellosis.
4. Scours.
5. Black quarter.
6. Anthrax.
7. Pneumonia.
8. Fowl typhoid.

1) Mastitis.

Infectious disease of mammary gland. May be acute or chronic.

Animals affected.

All animals with mammary glands. Cattle, sheep, goats, pigs, camel and horses.

Causal organism.

There are two types of mastitis.

a) Streptococcal mastitis.

Streptococcal agalactiae.

b) Staphylococcal mastitis.

Staphylococcus urens.

Predisposing factors.

a) Age.

Older animals are more likely to be infected as compared to younger ones.

b) Stage of lactation period.

Animals are likely to suffer from mastitis at the beginning and at the end of lactation.

c) Udder attachment.

Animals with a long pendulous or loosely hanging udders and long teats are more susceptible. Such udders are liable to mechanical injuries.

d) Incomplete milking.

Milk left in the teat canal acts as culture media for bacteria.

e) Mechanical injuries.

Wound on teats or udder allow micro-organisms entry into the udder.

f) Poor sanitation.

Increases the multiplication of bacteria.

g) Poor milking technique.

May result in mechanical injury of the teats and weakening of sphincter muscles of the teat.

Symptoms.

i. Milk contains pus, blood, thick clots or turns watery.
ii. When the udder and teat are swollen, animals reject suckling or milking and kicks due to pain.
iii. Death of infected quarter may result.
iv. Milk has a salty taste and there are fine clots or flakes particularly the fore milk.

Control and treatment.

i. The affected quarter of the udder is emptied of milk and an antibiotic is instilled.
ii. Use of the right milking technique.
iii. After every milking, use teat dip on every quarter.
iv. Strict cleanliness and use of disinfectants during milking.
v. Dry cow therapy. Infusion of long acting antibiotics into the teat canal when drying off the cow.
vi. A strip cup should be used to detect infection. Infected cows should be milked last.
vii. Use separate udder clothes for each animal or disinfect after milking each animal.
viii. Sharp objects should be removed from grazing and milking areas to prevent teat injuries.
ix. Open wounds on teats should be treated immediately.

2) FOWL TYPHOID.

Animal affected.

Domestic birds: chicken, turkey and ducks.

Causal organism.

Salmonella gallinarum.

Symptoms.

i. Birds shows signs of depression. They appear obviously sick.
ii. Respiratory distress and are dull.
iii. Drooping wings and sleepy eyes.
iv. Combs and wattles become pale and shrunken because of anaemia.
v. Greenish yellow diarrhoea.
vi. Birds dies within a few days.

Control and treatment.

i. All affected birds should be killed and properly disposed off.
ii. Poultry house should be clean, dry and well ventilated.
iii. Regular vaccination.
iv. Eggs for hatching and chicks rearing should be obtained from reliable sources.
v. Sulphur drugs mixed in water or mash for treatment. E.g. Furazolidone at 0.04% in mash for ten days.

3) FOOT ROT (FOUL-IN THE- FOOT).

Animals affected.

Infectious and contagious disease. Affect all cloven hoofed animals. Cattle, sheep and goats.

Causal organism.

Bacteria of *Fusiformis family.*

- ***Fusiformis necrophorus.***
- ***Fusiformis nodosus.***

Predisposing factors.

i. Filthy surroundings such as wet and muddy areas. Wetness causes skin between the hooves to soften and get cut by objects.
ii. Overgrown hooves that leads to their cracking.

Symptoms.

i. The animal's foot becomes swollen.
ii. There is a sign of pain as the animal walks making it limp. Lameness is observed.
iii. Pus and a rotten smell from the hoof.
iv. When the front legs are affected sheep are found kneeling when grazing.
v. Animals spend most of their time lying down when the hind feet are affected.
vi. Animals become emaciated due to lack of feeding.

Control.

i. Avoid dampness and muddy conditions.
ii. Regular foot examination and hoof trimming.
iii. Practise regular walk through a copper sulphate foot bath at 5-10% solution or formalin 2-5% solution.
iv. Wounds should be treated with antiseptics.
v. Healthy sheep should be moved to dry clean areas.

4) CONTAGIOUS ABORTION/BRUCELLOSIS/BANG'S DISEASE.

Animals affected.

Cattle, sheep, goats and pigs.

It is a zoonotic disease that is contagious and infectious.

- Cattle. *Brucella abortus.*
- Pigs. *Brucella suis.*
- Goats and sheep. *Brucella malitensis.*

Symptoms.

i. Spontaneous abortion or pre-mature birth.
ii. During the later stages of pregnancy, if abortion occurs, there will be retained afterbirth.
iii. The cow may become infertile while bulls have low libido and inflamed testis (orchitis).
iv. A yellowish brown, slimy, odourless discharge from the vulva may occur after abortion.

Control.

i. Use of artificial insemination.
ii. Affected animals should be culled, slaughtered and disposed well.

iii. Vaccinating all young animals against the disease.
iv. Avoid direct contact with the aborted foetus.
v. Blood test should be carried out for all breeding animals to detect the infected ones.
vi. Cleanliness should be maintained in the animal's houses.
vii. There is no effective treatment.

5) SCOURS/WHITE SCOURS/INFECTIOUS DIARRHOEA.

Animals affected.

Calves, piglets, lambs and kids.

Causal organism.

Bacterium.

Predisposing factors.

i. Unhygienic conditions in the houses of young ones.
ii. Poor feeding which includes:
- Overfeeding.
- Feeding calves on cold milk.
- Lack of colostrum.
- Feeding at irregular intervals.

Symptoms.

i. White or yellowish diarrhoea in calves.
ii. Faeces of affected animals have a pungent smell.
iii. High temperatures/fever.
iv. Animal becomes restless.
v. Loss of appetite/anorexia.
vi. Sunken eyes.
vii. Undigested milk and mucus with blood spots in faeces. Faecal matter sticks to the hindquarters.
viii. Sudden death if no treatment is given.
ix. Recovered animals generally remain weak.

Treatment and control.

i. Maintain cleanliness in animals' houses.
ii. Dampness on the floor of the houses should be avoided.
iii. Fingers must be disinfected if used to train young calves to drink from the bucket.
iv. Calving should be in a clean and disinfected area.
v. Have separate attendants for infected calves to prevent spread.

vi. When the first symptoms are observed, replace milk feeding with warm water mixed with glucose for a day. 1:1 milk: water ration mixed with glucose for 2 days and normal milk ration on the 4th day.
vii. Calf houses should have a raised floor.
viii. Treatment with antibiotics.

6) BLACK QUARTER/BLACK LEG.

Animals affected.

All ruminants 8-18 months old. Cattle, sheep after shearing and goats.

Causal organism.

Clostridium chauvei.

Chauvei septicum .which is spore forming and predominately living in the soil.

Enters the body through contaminated water or through wounds.

Symptoms.

i. Lameness. Becomes severe and the animal is forced to lie down.
ii. Affected parts become swollen immediately. (Hind quarters, shoulders and chest.)
iii. Rise in body temperatures.
iv. Heavy and fast breathing.
v. When swollen parts are touched they crackle (fizzing, popping sound).
vi. Animal becomes dull and goes off feed.
vii. The animal stops chewing cud.
viii. Sudden death occurs.
ix. There is grunting and grinding of teeth.
x. Bloody froth with a characteristic smell of rancid butter.
xi. Blood oozes from the anus and nose of the dead animal.
xii. If the affected muscles are cut, they appear dark.

Control.

i. Treatment using antibiotics e.g. penicillin, oxytetracycline and chlorotetracycline.
ii. Vaccination with Blanthax.
iii. Carcass should be buried deep or burnt completely.

7) ANTHRAX.

Acute infectious and notifiable zoonotic disease.

Animals affected.

All warm blooded animals; cattle, sheep, goats, man and wild animals.

Causal organism.

Bacillus anthracis.

Transmission.

- Bites from insects.
- Grazing in infected pastures. (Faeces of affected animals).
- Open wounds.
- Infected roughages, bones and bone meal.

Symptoms (in less severe form)

i. The animal is swollen on the underside of the belly. Extensive bloating of the stomach after death.
ii. The animal develops fever.
iii. Blood stains in faeces and in milk.
iv. Swelling of throat in pigs that may cause death due to suffocation.
v. Tar-like watery blood comes off the orifices e.g. nose, anus and mouth. Blood does not clot easily.
vi. Carcass of an anthrax lack rigor mortis that is stiffness of body after death.

Control.

i. Curative treatment. Large doses of anti-anthrax serum antibiotics e.g. procaine penicillin.
ii. Treatment of wounds.
iii. The dead animal must be burnt or buried very deep 2M deep and thorns put in the hole before refilling with soil. The area is then fenced to prevent other animals from grazing in that area. Calcium oxide is sprinkled on the carcass to kill any bacteria.
iv. Carcass should never be opened.
v. Vaccination using Blanthax.
vi. Quarantine in case of an outbreak.

8) PNEUMONIA.

Infectious lung fever.

Animals affected.

Calves, kids, lambs, piglets, poultry.

Causal organism.

- Bacteria or viruses.

E.g. contagious bovine pleuropneumonia is caused by *Mycoplasma mycoides.*

- Dust and worms in the lungs also cause the disease.

Predisposing factors.

i. Poor ventilation leading to lack of enough oxygen.
ii. Overcrowding.
iii. Age. Young animals are more prone to the disease.
iv. Effects of diarrhoea and other illness.

Symptoms.

i. Animals become dull and reluctant to move.
ii. Loss of appetite.
iii. Animals become emaciated.
iv. The animals breathes rapidly.
v. Abnormal lung sounds e.g. hissing, gurgling and bubbling when breathing.
vi. If chest is pressed, the animal starts coughing.
vii. Fluctuating body temperatures.
viii. The animal develops a rough hair coat.
ix. Nasal mucous discharge.

Control and treatment.

i. Young animals should be kept in warm pens.
ii. Proper sanitation should be maintained.
iii. Affected animals should be isolated for proper nursing in a warm pen.
iv. Early cases should be treated using antibiotics.

VIRAL DISEASES.

1) Rinderpest.
2) Foot and mouth disease.
3) Fowl pox.
4) Gumboro.
5) African swine fever.

RINDERPEST.

Notifiable disease and is highly contagious.

Animals affected.

Cattle, sheep, goats, pigs and wild animals that are cloven footed.

Causal organism.

Virus with an incubation period of 3-15 days.

Symptoms.

i. High temperatures.
ii. Starring coat.
iii. Discharge in the mouth and nose.
iv. Eyes appear watery.
v. Diarrhoea and dysentery.
vi. Mucus membrane of the mouth and nose become red, develops wounds or ulcers.
vii. The animal becomes emaciated.
viii. Animals grinding their teeth.
ix. Death in 2-10 days in acute cases or 3 weeks and above in less acute cases.

Control.

Vaccination every six months.

Quarantine during an outbreak.

Killing of affected animals.

Nurse animals with disinfectants on wounds. Antibiotics prevent entry of other diseases.

NEWCASTLE DISEASE.

Contagious and infectious disease of poultry. It is a notifiable disease.

Animals affected.

Virus.

Symptoms are in less acute forms.

Symptoms.

i. Birds have difficulties in breathing. Produce a harsh, grating rasping sound when breathing.
ii. Beaks remain wide open and necks are strained.
iii. Birds become dull.
iv. Birds stand with eyes closed all the time.
v. Birds loose appetite.
vi. Nasal discharge which force birds to shake their heads to clear it.
vii. Birds walk with staggering motion because the nervous system is affected. Paralysis of wings and legs may occur,
viii. Often the birds have their beaks and wings down.
ix. Birds produce watery greenish diarrhoea.
x. Eggs laid have soft shells.

Control and treatment.

i. No treatment.
ii. During outbreak all birds should be killed and the houses disinfected before bringing new stock.
iii. Vaccination.
iv. Quarantine.

FOWL POX.

Infectious disease of poultry.

Animals affected.

Chicken, turkey, pigeons.

Causal organism.

Avian fox.

Predisposing factors.

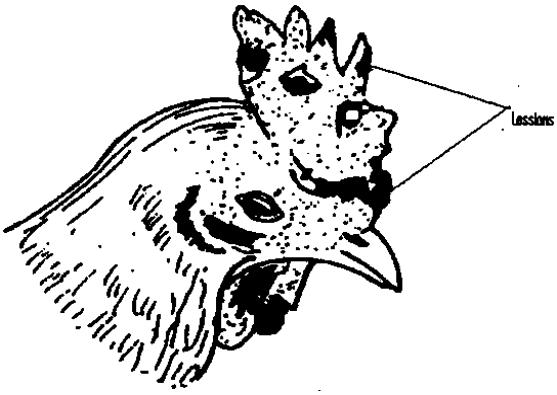
Presence of wounds.

Presence of mosquitoes, ticks, lice and other biting insects.

Symptoms.

There are 2 types of fowl pox.

- **Cutaneous type.**
- **Diptheric type.**



Symptoms of cutaneous fowl pox.

i. Lesions on the combs and wattles. At first they are small greyish white. Later they turn into a yellowish brown colour and are bigger in size.
ii. Lesions may occur on legs, vent, and feet and under the wings.
iii. In severe attack birds lose appetite, become emaciated and eventually die.

Symptoms of Diptheric fowl pox.

- Affects inside of throat and mouth mucous membrane.

i. In early stages the eyes and nose have a watery liquid discharge.
ii. Loss of appetite.
iii. Birds become dull.
iv. Birds are emaciated.

Control and treatment.

i. All affected birds should be removed and killed.
ii. The remaining healthy birds should be vaccinated.

GUMBORO DISEASE/INFECTIOUS BURSAL DISEASE.

Reported first in Gumboro in East coast of America.

Animals affected.

Chicken, turkey, pigeons and ducks.

Causal organism.

Birna virus.

Affects B-lymphocytes in bursa of fibricus (glands above the vent of birds).

Affects the thymus, spleen and caecal tonsils.

Incubation period is 2-3 days.

Symptoms.

i. The gland above the vent (Bursa) becomes swollen.
ii. Decrease in egg production.
iii. Respiratory distress.
iv. Affected birds' shows low water intake.
v. Severe immune-suppression making birds more susceptible to the diseases.
vi. In hot weather and high humidity mortality rate increases.

Control.

i. Vaccinate healthy birds with attenuated vaccines e.g. PGB98.
ii. Use vitamins especially B_{12} for fast manufacture of blood.

AFRICAN SWINE FEVER.

Highly contagious, infectious and fatal disease of domestic pigs.

Transmission.

Direct contact with reservoir animal.

Vectors.

Infected farm structures e.g. pig pens.

Animals affected.

All breeds of domestic pigs especially female pigs.

Causal organism.

Irido virus. It is highly resistant to putrefication heat and dryness. Survives in chilled carcass for up to six months.

Incubation period is 5-15 days.

Symptoms.

i. Rise in temperatures up to 40-41 degree Celsius.
ii. Loss of appetite.
iii. Animals becomes depressed.
iv. Coughing.
v. Nasal discharge.
vi. In serious cases the pigs start to diarrhoea.

Control.

i. Vaccinate animals in case of outbreak.
ii. Impose quarantine.
iii. Kill and dispose affected animals as well.
iv. Prevent consumption of pig products from pandemic areas.
v. Institute double fencing to keep wild animals away.

NUTRITIONAL DISORDERS.

MILK FEVER. ***Parturient paresis.***

Animals affected,

- Cows that have recently calved.
- Goats and pigs in similar conditions may be affected.

Causes.

- Low calcium levels in blood. This leads to increase in magnesium and sugar level.
- Occurs in high producing cows in first few months of lactation.

Symptoms.

i. Dullness.
ii. Muscular twitching causing the animal to tremble.
iii. The animal staggers as it moves.
iv. The animal falls down and become unconscious.
v. The animal lies down on its side and the whole body stiffens.
vi. Body functions such as urination, defecation and milk secretion stop.
vii. Sudden death if treatment is not prompt.

viii. Stomach contents are drawn into the mouth which later causes lung fever when breathing in.
ix. Complete loss of appetite.

Control and treatment.

Treatment.

Intravenous injection of soluble calcium salt in form of calcium borogluconate 60gms dissolved in 500cc of water that is boiled and then cooled.

Nursing care.

Sick animal should be kept in a comfortable position that is resting on its sternum.

Mechanical removal of urine will speed up recovery.

Do not give the animal medicine orally because of:

- It will not be able to swallow.
- The medicine may get into the lungs promoting lung fever thus speeding up death.

Prevention.

- For cows with past cases of milk fever, partial milking is done for the first 10days.
- Give high yielding cows' rations containing phosphorous and calcium.
- High doses of vitamin D and parathyroid extraction.

BLOAT.

Accumulation of gases as a result of food fermentation in the rumen.

Animals affected.

Attacks ruminants: cattle, sheep, and goats.

Causal organism.

- Obstruction of the oesophagus due to bulky food particles such as potatoes, carrots and mangoes.
- Abnormal pressure exerted on the oesophagus by a swelling in the wall of the chest.
- Indigestion. Caused by an accumulation of gases due to paralysis of the rumen and its entrance. E.g. due to ingestion of poisonous herbs or due to sudden change of feeds especially from soft green forage taken in large amounts.

Symptoms.

i. Left side of abdomen is excessively distended filled with gases that can be felt by pressing with hand.
ii. Death may occur within hours to the much pressure exerted on blood vessels, lungs and heart.

Control and treatment.

Feed ruminants with dry roughage during wet season before grazing on the lush.

Treatment involves the release of accumulated gases through:

Manual means. Exercising the animal and rubbing its abdomen with both hands and making slow prodding movement with fists. Stimulates the rumen movement.

Surgical means. Use of stomach pump, or piercing the abdomen wall using trocar and canula or a sharp knife.

Chemical means.

- Drenching using suitable oils e.g. turpentine oil mixed with vegetable oil.
- Administering Epsom salt to clean the reaming rumen content. Given as a drench.
- Administration of methyl silicone as an injection directly into the rumen. Prevents frothy (bubble) type of bloat by increasing surface tension of the food mass in the rumen.

-END.-