GENERAL INTRODUCTION TO AGRICULTURE SCIENCE

THEME 01 : GENERAL INTRODUCTION TO AGRICULTURE SCIENCE

Definition of agriculture- Is the science and art of cultivating crops and raising livestock to produce food and goods for human beings.

The word art is used referring to the skill of the farmer in cultivating crops and raising livestock.

The word science is defined as knowledge of nature. Farmers use the knowledge gained by scientists to grow their crops and livestock.

IMPORTANCE OF SCIENCE IN THE SOCIETY

• Used in food processing

• Used in crop production

• Used in making pesticides

• Used in making fertilizer

• Help in producing new breeds of animals

• Used in food preservation.

• Help to know what endanger animal and crops

THE SCOPE AND INTEGRATION OF AGRICULTURE WITH ARTS AND SCIENCE SUBJECTS

Biology:

Involves breeding of crops and livestock.

Geography:

Involves crop and animal distribution soil and water conservation.

Mathematics:

Involve production economics and research, farm survey, mechanization finance and soil science.

Chemistry and physics:

Biochemistry, Animals and crop science and protection soil chemistry, farm mechanization

Zoology:

Animal production science veterinary medicine.

Sociology:

Agricultural extension and education.

Economics:

Finance and marketing.

HOW FARMING BEGAN

In Prehistoric times, people liked by collecting fruits, seeds, leaves and roots of trees they come across in the bushes and forests, and by hunting wild animals. Men started as food gathers and hunters. They lived in very small combinations and the population was so small that there was no difficulty in obtaining enough foods.

The first big discovery was the cultivation of land by scratching the ground with wooden sticks and growing some wild edible plants.

After undergoing many generations of selection and breeding, this gave rise to the cereal crop varieties we grow at present. Various types of wild animals and birds were caught and tames, later to become domestics animals. Due to these developments some form of settled agriculture started, but the use of poor tools remained a common feature.

The arrival of Europeans in East Africa Market a further Improvement in farming methods. Cash crops and exotic breeds of livestock were introduced the cash crops being mainly intended to

provide raw materials for industries such as the textile industry in Lancashire back in England. The revenue from the cash crops helped the colonies to pay for their administrative costs, thus reducing dependence on the colonizers. However more attention was paid to the European that to the African farmers.

BRANCHES OF AGRICULTURE SCIENCE

The subject material of agriculture entails much subdivision namely:-

1. Crop husbandry:

This is also known as crop science, it deals with botany and examines plant life cycles, weeds, rests and diseases and their control, plant breeding and genetics.

2. Animal husbandry:

This is animal science that deals with the rearing of all types of livestock e.g. cattle, poultry, sheep, goats, pigs and rabbits. It also involves all factors that influence the production performance of livestock so as to obtain high yield of animal's products of goods quality both for human consumption and for industries.

3. Soil Science:

Involves the study of soil in general, how it works, how the soil is formed, how it works to sustain life and how it can be kept alive through many years of use.

4. Agricultural machinery:

Deals with tools and machinery used in farming activities, modern farming require the of tools and machinery so as to enable farmers to save time and cope with large amount of work while stepping up the yield. Farm modernization cannot be achieved without using machines.

5. Agriculture Economics:

This branch of agriculture provides information on basic economic principles, gross domestic product and income per capital in relation to agriculture development and the day to day activities.

IMPORTANCE OF AGRICULTURE

Importance of agriculture to the farmers

1. Agriculture provides foods

The food may be obtained from growing crops in the garden or from animal's sources,

where we get meat, milks and milk products, egg and blood. It's the duty of every nation

to feed its people because a well fed nation is a health one.

2. Agriculture provides employment:

Workers in ranches, coffee, tea and sisal estate and small holders' farmers are all

employed through agriculture sector.

3. Clothing:

Agriculture generates materials from which clothing is made. Fibre from cotton and other crops is processed in a textile industry to produce cloth. Woolen clothing and leather materials like shoes, belts, jackets and handbags are obtained from animals.

4. Money:

Crops, animals and animal products are sold for cash

5. Consumer goods:-

The manufactured products which farmers use for domestic purpose such as sugar, soap, cooking oil and others are all processed from raw materials obtained from the agriculture sector.

6. Shelter:

The agriculture sector generates the materials which farmers use to put up their houses. Shelter is one of the basic requirements of man.

7. Agriculture provides raw materials for industries most agriculture products require some.

8. Labor:

Some animals such as oxen, donkey and camels are used on farms for ploughing and providing simple transport.

9. Fuel:

Crop residues are used as firewood or charcoal.

10. Social, Cultural, Traditional value:

Payment of dowry and fulfillment of traditional ceremonies and rituals must be done in material form by presenting one or more of these animals as the custom demands.

SCIENTIFIC PROCEDURES USED IN AGRICULTURE SCIENCE

Scientific process

Agriculture science subject needs scientific methods of research and investigation. One can study living things either by field observation (outdoors) or laboratory experimentation (indoors). Scientific process is activities that deal with experimentation in chosen phenomena in science and finding a solution to a problem.

Importance of scientific procedure

- To determine plants and animal requirements
- To determine pest and disease which affect plant and animals
- To develop suitable new plants varieties and animal breeds.

Procedural method

(i) Problem Identification

(ii) Formulation of hypothesis

(iii) Experimentation

(iv) Observation and Data Recording

(v) Interpretation of Data

(vi) Conclusion

(i) Problem identification

Is the first step where problem is recognized

(ii) Formulation of Hypothesis:

Hypothesis – is an intelligent guess, a tentative theory or tentative explanation and hypothesis formulation

(iii) Experimentation; an experiment is a series of investigations intended to discover certain facts. This may lead to the acceptance, modification or sometimes rejection of a hypothesis

(iv) Observation and Data Recording

After setting up an experiment, a researcher makes careful observations and records all events that he considers important.

(v) Interpretation of Data:

Once a researcher has collected data he / she should try to explain what the data means in relation to the purpose of the experiment.

(vi) Conclusion

A research must draw conclusions at the end of the investigations based upon collected data. The conclusion is either a confirmation or rejection of the hypothesis under investigation. When a hypothesis is rejected another one is formulated and tested.

AGRICULTURE SCIENCE LABORATORY

Meaning of the concept:

The word laboratory originated from a Latin word laborer which means labour (work hard) this suggests that the laboratory is a place meant for serious hard work and not for jokes.

Definition

It is a room or a building specially designed for Agriculture experiments and also where specimens and apparatus are kept.

Characteristics of a good laboratory

- Supply of gas
- Electricity and water
- Large windows to allow enough light and air

The laboratory is meant to be a quiet and safe place to work in. It can be a dangerous place if safety regulations are not adhered to.Importance of Agriculture Lab

The laboratory can be used for soil analysis

- The laboratory can be used to conduct experiments for examine plants and animals requirement
- It used for examining different plants and animal rest and diseases
- Can be used to store different Agriculture science chemicals, fertilizer, seeds and apparatus for future use.
- Can be used to develop new crop varieties and animal breeds.

Safety in Agriculture laboratory

When an experiment is being done, it should never be assumed to be completely harmless. All chemicals and apparatus should be handled with great care. For instance, if a glass apparatus is handled carelessly, it might break and injure the user.

Safety laboratory rules

Students should never handle any chemicals specimens and apparatus in the laboratory without instructions from the teacher. Students using any chemical must adhere to the teacher's instructions, very carefully to avoid accidents.

Any accident involving chemicals or apparatus in the laboratory must be reported to the teacher in charge immediately so that first aid can be administered.

Put off flames which are most in used.

When heating a substance, never point the open end of the tube towards yourself or anyone else. Always hold tubes using test-tube holders when heating.

Always keep inflammable substances away from flames.

Don't play or run in the laboratory

If need be wear lab coat, gloves, goggles when carrying out an experiment or practical's.

ALWAYS work on a clean bench. After completing your experiments. Clean all pieces of apparatus and specimens one has used return them to their correct places.

TYPES OF APPARATUS USED IN AGRICULTURE LABORATORY

- Beaker
- Brush
- Glass wool
- Bucket
- Beam balance
- Measuring cylinder

- Test tube
- Thermometers

FIRST AID

Definition

Is the immediate and temporary care of help one is given when injured or ill before being taken to the hospital or before the doctor comes

Importance of first Aid

- Saves life
- Bring hope & encouragement
- Prevent further heading or injuries
- Helps the patients to recover from shock
- Removes fear of death
- Reduce pain

Component of the first Aid Kit Importance of first AID

- A pair of scissors
- Rolls of adhesive tape
- Assorted bandages
- Cotton wool sterilized
- New razor blade sterilized
- Jar of petroleum jelly
- Gentian violet solution
- Soap
- Antibiotic solution
- Pain killers: e.g. panadol
- Methylated spirit
- Clean water

THE CONTRIBUTION OF AGRICULTURE TO NATIONAL ECONOMY

1. Food supply

All the people require food; it's the agricultural sector that meets this basic need. A starring nation is a poor one; threatened by Malnutrition, disease and death. A country's economy is strong when its people are well fed, enjoy good health and are able to steer their nation through progress and prosperity.

2. Supply of raw materials for industries

Raw materials mean that the materials have come from the crops or livestock without being altered or treated.

Examples agricultural raw materials

- Sisal for bag industries
- Groundnuts and sunflower for oil Industries
- Leather goods – leather industries
- Cotton – Textile industries

3. Agriculture creates employment In East Africa, over 80% of the able-bodied men and women are engaged in Agriculture.

- Agricultural chemicals (fertilizers, pesticides, fungicides), machinery, certified planting materials.
- Marketing of Agriculture products
- Agriculture extension & education
- Unskilled and semi-skilled are employed to cultivate, weed and harvesting plantation crops such as sisal, coffee, tea and pyrethrum.

4. Earning Foreign exchange

East Africa countries export (sell to other countries) things like coffee, tea, cotton, fruits and vegetable.

5. Source of market

It provides a market for the industrial products.

e.g. jembes, fertilizer, pesticides, herbicides, animal feeds and veterinary drugs needed by the farmers as inputs in farming.

6. Source of capital

High agricultural produce generates wealth at home and also accumulates savings in the form of foreign reserves.

7. Improves the standard of living of the people because it gives them good health, shelter, clothing and more wealth.

AGRICULTURAL DEVELOPMENTS IN TANZANIA

Basic facts of Agricultural development in Tanzania

(a) Suitable land for crop production and animal keeping

Tanzania has large suitable land for Agriculture but only small part has been put into use

(b) More than 80% of the population is living in rural area where farming is the major activity

(c) Agriculture in Tanzania is based on small scale farming owned by poor peasant while large scale is owned by private companies or governments.

(d) Peasant farming produces little for family use as well as cash crops.

(e) Agricultural development is a Major source of economy and social development in Tanzania

SOCIAL ECONOMIC AND TECHNOLOGICAL PROBLEM FACING AGRICULTURE DEVELOPMENT IN TANZANIA

Poor crop and animal husbandry.

Due to low level of education farmers fail to practice recommended practices e.g. properly timely fertilize. Use etc. hence ending up with low-harvest.

Poor marketing system

Poor transport structure from the field to store as well as from store to market causing spoilage and destruction.

Psychological and sociological factor i.e.

Perception that farming is for old, poor and less educated people and a white collar job is for young, educated class.

Religious beliefs hinder rising of some animals or crops e.g. pig production, tobacco production.

Poor farming tools:

Use of traditional hand tools is prominent in most area; thus lowering production.

Pest and diseases:

Capital (Money) is needed in purchasing chemical treatment which most farmers cannot afford.

Price fluctuation:

Due to change of supply and demand of farm products time to time, may discourage farmers to produce a certain commodity.

Poor storage

Poor storage facilities in rural farming community may cause spoilage of harvests by pest, weather for at least 20%.

Climatic factor

Unreliable and insufficient rainfall per annul have a great effect in farming operations e.g. drying of crops, less pasture for animal, heavy outbreak of pests etc.

Remedial steps

Farmer's education

Through improvement of extension services to convey proper skills to farmers

Research Centers

It's important for development of proper animal breeds and crop varieties suitable t o varies areas and made available to farmers.

Improvement of transport system

Through establish and construction of good road and railways in order easy movement of raw material from the field to the market.

Improvements of laws tenure system

By establishing land title dead as incentives to farmers so that they can secure loans and do large investments.

Provision of storage facilities

To facilitate agriculture products to be store for a reasonable period for future use

AGRICULTURE MECHANICS

THEME 2.0: AGRICULTURE MECHANICS

Introduction

In order to do work Energy must be expended / used. The rate energy expenditure, proportional to the rate of doing work is known as power.

TYPES OF ENERGY

Animated

Is energy expended by using muscular power of human being and animals.

Unanimated

Energy expended through transformation of natural sources e.g. water, wind, solar and fossil fuel. Meaning of the concept is the application of engineering principles and technique in agriculture activities involving utilization of all forms of energy through mechanical assistance in agriculture production.

Devices provide mechanical assistance include

(i) Tools;

This is a piece of equipment that have only few parts connected together e.g. slashes, hoe, discs, blades

(ii) Implement;

A more complex than tools in that it has large number of parts connected together e.g. ploughs, disc harrows, ridges.

(iii) Machine

A most complex of the three as it is an assembly of connected parts which can move relatively to each other in a controlled manner e.g. mowers, harvesters and planters etc.

ADVANTAGES OF AGRICULTURE MECHANIZATION

A major reason for mechanization agriculture is to increase production

Ways to which production are improved by mechanization

(a) By bringing about more intensive production through more effective and timely operations, increased speed of working and increased capacity to do hard and difficult operation such as land clearing and sub-soiling.

(b) By putting more land into production

Based on the two ways listed above, therefore, the advantages of agricultural mechanization include:-

(i) Relieving labour bottlenecks at peak period such as those occurring during weeding and harvesting.

(ii) Increasing labour productivity by doing each operation at the proper time

(iii) Increasing labour productivity and employment during stack periods

(iv) Reducing drudgery involved with hard or dirty work, such as manure spreading and clearing.

(v) Encouraging human and industrial development through increased profit from mechanized agriculture

(vi) Possibility of reducing production costs

LIMITATIONS OF AGRICULTURAL MECHANIZATION

Several factors limit the effectiveness of mechanization in agricultural production. These include:-

(a) Physical factors such as mechanizing mountainous areas with steep slopes, oxenization programmes in tsetse-infested areas

(b) Biological factors, cassava root harvesting machinery, rest and diseases

(c) Technical and educational factors; development of knowledge, attitudes, skill required to operate, maintain & services agricultural development.

(d) Economic factors, understanding of cost and benefits of operations for maximum efficiency and output.

DISCIPLINES OF STUDY OF AGRICULTURE MECHANICS

(i) Land and water resource development

- Preventing excessive water loss by retaining the needed i.e. water conservation
- Controlling excessive soil loss from field I,e soil conservation

(ii) Processing and storage of agriculture products;

Activities involving processing of raw agriculture products e.g. vegetables, fruits, grains in processing industries.

(iii) Farm survey and mapping

Include farm structure e.g. buildings fences, dips crushes, roads etc

(iv) Plant and animal production

Activities including farm operation involved in crop and rising livestock

FARM TOOLS AND EQUIPMENT

Introduction

There are many operations and tasks that are performed in the farm during crop and livestock production. Some of these tasks are so complicated that they cannot be performed to one's satisfaction by use of mere hands. A farmer therefore needs various tools and equipment.

Tools are quite simple and are held in the hand as one performs a particular operation.

Why farmers use tools and equipment

- To increase efficiency and make farm operations easier
- Farm jobs can be done easily and quickly
- To minimize injuries to livestock
- They relieve farmers of fatigue from tiring tasks
- To enhance production

- Enable farmers to produce better quality products

Categories of farm tools and equipment

There are five categories of farm tools and equipment

- Garden tools and equipment
- Workshop tools and equipment
- Livestock production tools and equipment
- Plumbing tools and equipment
- Masonry tools and equipment

The choice of the tools in any of the categories will depend on various factors; such as:

- The task to be performed
- The tool's efficiency
- The level of knowledge
- Skill of the user
- The availability of the tool

Garden tools and equipment

These are all the tools and equipment that a farmer needs for crop production. Right from the first stage of crop production up to the final stages of harvesting and post-harvesting practices, a number of tools are required to carry out most of these activities efficiently.

There are many field management practices that are done in the farm such as:

- Pruning
- Pest and disease control

□□□□□□□□□□□□ • Watering

□□□□□□□□□□□□ • Weeding

□□□□□□□□□□□□ • Transplanting, Drying the grains

□□□□□□□□□□□□ • Earthling up, harvesting

□□□□□□□□□□□□ • Transportation e.g.

These tools include

Hand hoe or member, used for seedbed preparation, planting and hank sting of roots crops

AXE: Used to cut down trees

Pick axe and Mattock: Used for digging up stones and tree stumps (roots)

HOE: Used for seedbed preparation, planting weeding and harvesting of root crops

FORKED HOE: - Used for removing underground perennial weeds, digging hard, store wet or muddy soils and harvesting of tuber owns i.e. Irish potatoes.

SPADE: Used for digging in place of a jembe e .g in stone places and removing soil when digging holes and applying manure

Wheel barrow: Used for transporting small load like sand, bags of seed or seedling during transplanting, bags of fertilizer within a short distance.

SPRING BALANCE: - Used for weighing farm produce and farm inputs.

RAKE Used for collecting together uprooted plant roots and stems, rhizomatous weeds or precious crop residue.

• Breaking large soil clods and removing stones and other rubbish to obtain afire tilt for tiny seeds.

• Leveling and finishing off the seedbed

• Collecting mowed grass.

Water pump and Watering can: Used for watering seedling in seedlings in seed boxes, potted plants, nursery beds, transplanted seedlings and seeds.

Tape measure: Used for meaning distance and length

Soil Anger: Used for soil sampling i.e. during soil analysis/ testing digging holes for fixing fence posts

Knapsack sprayer: used for applying agrochemicals such as folia fertilizer, herbicides or pesticides to crops efficiently economically and safely.

Sprinkler: used for applying water to crops in overload safely. Used for applying water to crops in over head irrigation.

Hose pipe:

Used for conveying water from one area to another

Garden shear:

Used for trimming hedges and shrubs in the farm

Pruning saw:

Used for pruning perennial crops like coffee, citrus fruits and pollarding trees.

Meter rule:

Used for measuring out distance

Secateurs:

Pruning crops like coffee and cutting unwanted branches and sucker of flowers

Garden trowel: Used for loosening the soil

- Digging small shallow holes
- Lifting out seedling from the nursery beds during transplanting

Garden fork

Used for weeding in a nursery or carrot fields, preparing holes for transplanting seedling

Manure fork:

Used for turning and collecting manure on the farm

Pruning hook:

Used for cutting branches of tall trees

Pruning crops like tea

Shovel:

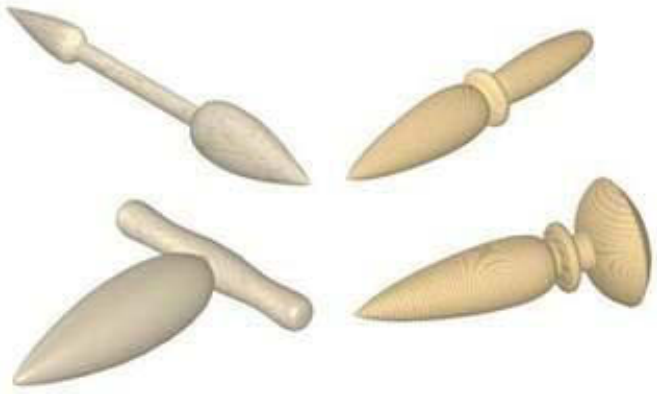
Used for scooping loose soil, fertilizer, seeds and sand

Leveling board:

Used for leveling a prepared seedbed especially in rice fields.

Dibber:

Used for making holes into which seedling can be transplanted



Sickles:

Used for cutting grass and harvesting cereal crops like rice

Anvil pruner:

Used for pruning in coffee, cocoa and rubber plantations, in vineyards and orchards and for horticultural purposes.

LIVESTOCK PRODUCTION TOOLS AND EQUIPMENT

These are tools and equipments used for routine management practices in livestock e.g.

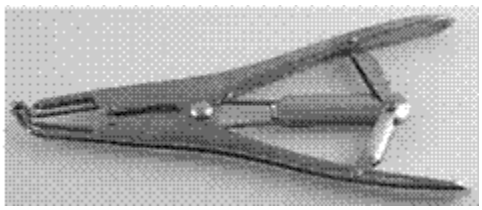
- Identification
- Castration
- Dehorning
- Disease and parasite control
- Breeding
- Milking and
- Restraining animals

They facilitate easy handling of the livestock thus minimizing injuries to livestock and to the stock handlers.

Elastrator:

To enlarge the rubber ring during castration of small livestock

- To de-horn livestock
- For the docking of lambs



Burdizzo

Used for bloodless castration of bulls, rams and Billy goats by snapping the spermatic cords.

Syringes and hypodermic needles

Used for administering injections and taking blood samples

Syringes can be for administering liquid drugs e.g. vaccines and to infuse antibiotics into the teat canal for preventing of mastitis.

Thermometer

Used for measuring body temperature of livestock by placing it in the rectum for a given period of time.

Halter

Used for restraining cattle. It prevents chocking of the animal and ensures complete control of the animal.

Hoof trimmer

Used for cutting or trimming overgrown hooves of livestock e.g. cattle, sheep and goats

Strip cup

Used for detecting mastitis in milk, the drop shows clots on the black plate

Tracar and canula

Used for relieve bloat in livestock through piercing the rumen to release gases.

Wool shears

Used for clipping or shaving wool in sheep

Ear notcher

Used for cutting identification shapes on the ears of an animal

Bull ring and lead stick

Used for restraining bulls, it gives the handler a safe distance from vicious which can be dangerous on coming closer to handler.

Bucket:

Uses for holding milk during hand milking

Fetching and transporting water

Milk churn:

Used for storing of milk and transporting milk

Milk strainer / sieve

For removing any visible foreign matter
Hot Iron

Apply heat to the horn buds to destroy the cells and prevent horn growth from these buds

Teeth clipper

For cutting of wolf-teeth in piglets

Drenching gun / dosing gun

For oral administration of liquid drugs to animals e.g. during deforming

Bolus gun

For deforming orally using solid drugs (tablets)

MAINTENANCE

Looking after tools is sometime called Maintenance

If you use your tools correctly and look after property they will last much longer

- The metal surfaces must be cleaned after you have used the tools
- Scrape off any soil and moisture
- If it's still damp it may be left in the sun to dry
- Do not forget it and not let the rain fall on it
- Grease to stop rusting (oil or greasy)
- Do not hit one tool with other
- Sharpen and replace handles
- Replace lost bolts and nuts
- Store properly in a tool rack or tools cabinet
- Replace worn out blades
- Tighten loose nuts and bolts
- Lubricate to reduce friction
- Coat with oil to prevent rusting

FARM WORKSHOP

Is a place where storage, maintenance repair as well as fabrication of metal is done

Types

- Mobile workshop

- Stationary workshop

Quality of a good workshop

- Should be at the centre of the farm
- Should be in a well drained soil
- Should have all the necessary tools and equipments put not expensive
- Ample room for easy movement
- Should be well ventilation

Advantages of a workshop

- Reduce costs which will be incurred for repair and maintenance
- It ensure continuous farm operation as repair is quickly in time
- Offer time economy in relation to operation due to varying season's

Location of the workshop

- Should be constructed at the centre of the farm for easy access
- Should be located in a well drained soil for easy passage
- Should be located in a place convenient to other projects e.g. poultry
- Should be have good ventilation
- Firefighting equipment should be well placed
- Walls should be high enough to allow easy passage of heavy duty vehicle
- Floor should be made of concrete
- Extension floor should be provided for storage of implements and machinery

Layout of the workshop (features)

- Main overhead area
- Washing and service place
- Staff office
- Wood working area (carpentry)
- Metal working area

Safety precaution

(a) House keeping

- Working space should be kept free from Obstructions
- Floor should be kept clean by wiping spilled grease and oil and disposing all junk and rubbish promptly
- Benches and tools should be cleaned and properly arranged

(b) Personal protection against injury

- All tools should be kept in good condition
- Wear goggles and use shield when grinding or welding
- Take care when using powered saws and other sharp tools
- Safety boots should be worn and machines having belt and gear should be fitted with guards to avoid accidents

(c) Protection against fire hazards

- All flammable liquids should be stored in approved containers
- Make partitions using metal sheets or asbestos cement board where forges and welders are installed

□□□□□□□□□□□□□□□□ • Fire extinguishers should be easily accessible

Wood work

Timber can be classified into

□□□□□□□□□□□□□□□□ • Soft wood – from trees with needle like leaves

□□□□□□□□□□□□□□□□ • Hard wood - from trees with broad leaves

There are two methods used to convert a tree into boards or planks

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□□□□□□□□□□□□□□□□ • Quarter or kift saw

Basic woodwork tools

Saws

(a) Cross-cut saw - used for cutting across the grain of timber

(b) Rip-saw - Cutting wood a long grain / splitting log

(c) Dovetail – saw - Cutting dovetail joints

(d) Ten on/Back saw - Cutting joinery work in wood work of cutting wood grain in any directions

Plane

(a) Jack plane - Used for sharing the surface of timber/wood make wood plain

(b) Smoothing plane/Finishing plane – Finish the surface after jack plane

(c) Try plane - General purpose

Hammers

Wooden mallet - is used to drive in wood chisels

Claw hammer - For driving nail into wood and removing nails from wood

For straightening nails or metal

Ball-pain hammers

- For straightening metal sheets and rods
- For riveting
- For driving in nails

Sledge hammer

- For demolishing farm structures
- For driving pegs into the ground
- For breaking big stone

Spoke have

It is used for cutting and shaping circular work and forming the curved edges of board

Planning curved surface

Rasp/wood file

For smoothing wood surface

Others saws

Bow saw - Used to cut thin and irregular curves

Power chain saw - Used for lopping and cutting tough wood

Saw set pliers - Setting the teeth of saws

Compass saw - Use for cutting in irregular lines or curved surfaces and narrow places such as holes

Keyhole saws: A tapered and narrow blade like compass saw but its blade is

Much smaller and longer

Metal work

Hacksaw : Cutting wires and metals

Cold chisel : For cutting heavy gauge metal sheet

For cutting shapes in metal sheets

Single cut file and double cut file

For smothering or sharpening bladed of cutting tools

Divider : To scribe area or circles on metal work

Wire brush : For cleaning the vices or to remove metal chippings in files

Centre punch: For marking points on the surface of metal sheets before drilling

Screw driver : Driving in and out of metal or wood surfaces

Try square

Used in both wood and metal work

Used for checking squareness (measuring of 45áµ’ and 90áµ’) when joining piece of wood or setting doors and window frame etc.

Mallet

Used both in wood work and in metal work.

Used for shaping thin sheets of metal this could be damaged by using steel hammer.

G-clamp

Used both in woodwork and in metal work

- Used fir fastening parts of wood together e.g. doors window etc
- For holding together pieces of work when performing other tasks such as saving and cutting timber

Soldering gun

For melting rods or soldering wires when repairing or fabricating metal sheets or when joining wire using solder

Tin-snip

For cutting thin sheets of metal and iron

Ball-pain hammer 

- For straightening metal sheets and rods
- For riveting
- For driving in nails

Marking gauge 

Used for making parallel line on wood

Wood joint

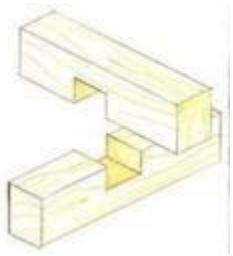
Every place that two pieces of wood meet each other is considered to be a joint. Most joints are held together with some sort of outside force such as glue, nails, staples, or screws. Joints are crucial to any type of wood construction. This includes furniture building, housing framing or picture framing.

Types of joint

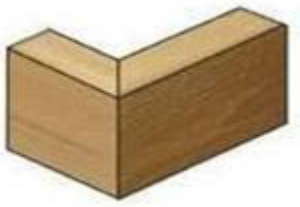
(a) Butt joint; Is the simplest and most easy joint to create where two pieces of wood joint

side by side by inserting dowels or nail and gluing together.

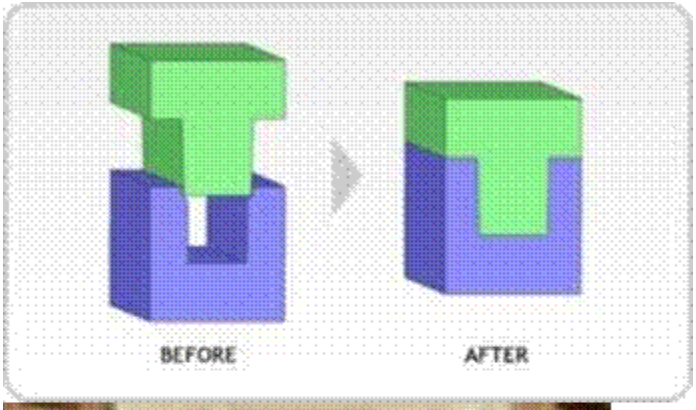
(b)Halving or Halve tag joint; this can be corner-lap or a cross-lap. A corner-lap joint form a right angle where the end of both pieces meet while a cross-lap joint formed when two pieces cross each other.

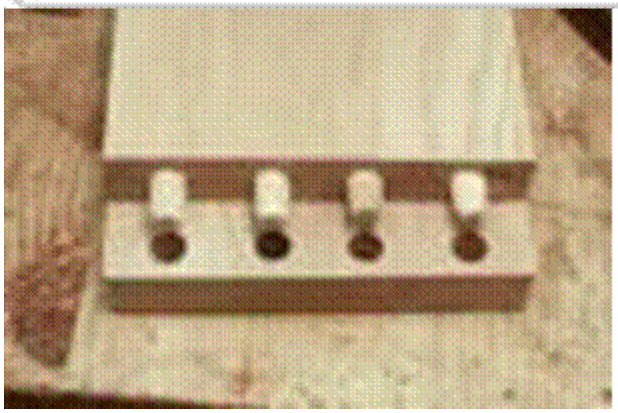


(c) Mitered butt joint; is similar to the standard butt joint, in that it typically joints two boards at the end meeting the side of another board.

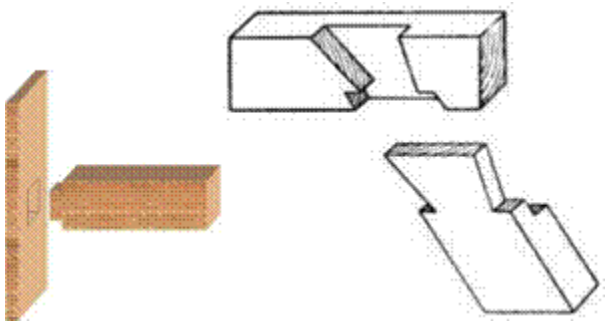


(d)Tongue and groove joints; this type of wood joint holds two boards together along their edges rather than their end or in the centre.





(e) Mortise and tenon joint; it involves one board being fitted inside of a second board. The mortise is a square hole curved into the side of aboard. The tenon is a protruding pieces coming off the end of a second board



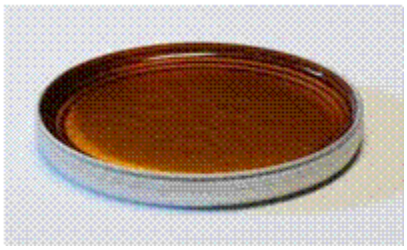
Dove tail joint

Method of metal joining

Metal plate can be joined by nut, bolts, screws and studs, resulting in temporary joint. Joint may be accomplished through riveting, gluing, soldering, brazing and welding, resulting in permanent joints. Permanent joining requires more specialized skills and relatively sophisticated equipment.

1. Soldering; is the process of joining metal parts by means of a fusible alloy called solder.

The molten solder is applied between the parts to be soldered. When the solder has cooled and hardened, the joint is complete. There are two types of soldering; (a) Soft soldering which require low temperature. (b) Hard soldering; requires high temperature. Soldering equipments include soldering iron, soldering stove, fux, brush, and tinman's solder



2. Welding; is the process of join two pieces of metal by melting them locally together with a filler rod. This is done by gas or arc welding.

3. Forging; Is the process by which heated metal is hammered into the required shape. This is achieved by the use of the following equipments. Hand fan forge to provide heat can be fire by charcoal or coal, Anvil used to support the work piece while it's hammered

Sledge hammer used for striking the metal directly or by striking forming tools

Tongs; used for holding the heated metal. In the process of forging, the metal is heated into correct temperature by using a hand fan forge then hammered into shape quickly before its looses heat.

PLUMBING

It involves the cutting, threading and fitting pipe; piping materials include lead, cast iron, and asbestos cement, copper, plastic pipes.

Plumbing equipments includes;

(i) Pipe cutter; for cutting pipes

(ii) Pipe stock; for marking threads on the pipe

(iii)A pipe wrench ; used for fitting pipe

Types of pipe fittings

a) Couplings; for connecting pipes in a straight line

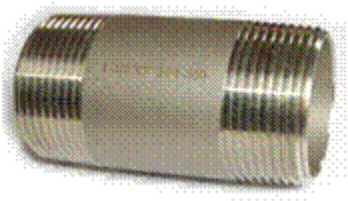
Plain coupling; for connecting pipes of the same size

Reduced couplings are used for connecting pipes of different sizes

b) Elbows; Are used to change the direction of the run of a pipe, usually comes in 90áµ’ and 45°. They may be plain or reduced elbows.

c) Tees; Used for branching off the main pipe line.

d) Nipple; Are short pipes with thread on both end, are used to connect two fitting



e) Union; Are used for connecting two pieces of pipes where either one can be turned or where part of the system will be removed for repair or replacement

f) Pipe valves; Are fitting connected within a pipeline system in order to control or shut off the flow through the line.

CROP PRODUCTION

THEME 3.0: CROP PRODUCTION

Introduction to crops science and production

There are many 350,000 known species of plants in the work but relatively few of these have been used.

Those plants which have been identified, domesticated and cultivated are called crops.

Origin of crop plants

There is archaeological evidence that crop production dates back to 9000-7000 BC in both the Middle East and South America.

Definition

Crop plants: Are plants grown by farmer for economic importance.

Crop science: Is the study and use of scientific method to rise or grow crop plants. Crop production: Is the growing of crop plants for food and other purpose. Classification of crop plants grown in Tanzania.

(a) Agronomic classification:

Crops are grouped according to their various products. The crops belong to definite botanical families.

- Cereal crops or grain crops –maize, paddy.
- Grain legumes or pulses-groundnuts, cow peas.
- Tuber crops.
- Root crops.
- Fruit crops.
- Sugar crops.
- Oil crops- simsim, soya beans, cashew nut, and sunflower.
- Vegetable crops – cabbage, okra, lettuce, tomatoes
- Forage crops – guinea grass, Rhodes grass, elephant grass
- Medicinal and drug crops – tobacco, pyrethrum
- Ornamental – Hibiscus, Bougainvillea & Roses

Fiber crops – are crops which contain fibers in the leave, stem, and bear fiber on their seeds

- Fibers on seeds – are cotton and kapok
- Fibers on leaves – sisal
- Fibers on stem – hemp, jute and kenaf

Cereal crop or grain crops

These are members of the grass family. All of them are annual crops

Characteristic of cereal crops

- Bear seeds which are called grains (grain crops)
- Have long leave with parallel vein

□□□□□□□□□□□□□□□ • Are annual crops

□□□□□□□□□□□□□□□ • Have fibrous roots

Examples of cereal crops

Maize, paddy, bulrush millet, sorghum, millet, wheat and barley (shahiri)

Oil Crops

Are crops which bear seeds / fruit which contain oil. Most of them are annuals – others are perennials

Examples: groundnuts, sunflower, cotton, simsim, soya bean, castor, cashew nuts, sunflower and coconuts.

Fiber crops

Are crops which contain fibers in the stem or bear fibers on their seeds

Examples: Cotton, kapok, sisal, hemp and kenaf

□□□□□□□□□□□□□□□□□ • Which bear fibers on the seed – cotton and kapok

□□□□□□□□□□□□□□□□□ • Which produces fibers in the leaves sisal

□□□□□□□□□□□□□□□□□ • Which produce fibers on stem, hemp, jute and kenaf

Beverage crops

Beverage crops produce fruit or leaves which are used for making refreshment drinks (beverages)

Example: Coffee, tea and cocoa

Legumes

Are crops which produce fruits with a carpel that splits along the edges. Legume contain large of protein. Bear seeds with a large amount of oil as well. Examples: Haricot beans, cow peas, grams, groundnuts, pigeon peas, and bonavist beans

Root crops

Are crops which store food reserves either in the roots e.g. cassava and sweet potatoes or on the bottom parts of the stem e.g. potatoes.

Examples: Cassava, potatoes, sweet potatoes and yams.

Fruits crops

Are crops which bear fruit which can be eaten in a raw state when ripe.

Examples: Citrus (oranges, tangerine and lime), pawpaw, pineapples, pears, apples, peaches, vines and plums.

Medicinal crops

Are crops that contain toxic or curative substance which are beneficial to human being.

Examples: pyrethrum, tobacco, cinchona and cloves

Spice crops

Spice crops produce fruits, flower or barks which are used by human beings to improve the taste and / or aroma of food

Examples pepper, cloves, cardamom, cinnamon and ginger.

Vegetable crops

Vegetable crops are grown for use as vegetable.

Examples: Tomatoes, onions, cabbage, okra, leak, lettuce, radish, cauliflower and egg plant.

Forage crops

Are crops grown for feeding livestock especially cattle, goat and sheep

Examples: Guinea grass, Rhodes grass, elephant grass and legumes (Lucine, stylo, clovers, and Centro.

Ornamental

Are plants which are grown for decorative purpose such plants producing leaves or flower which has attractive colours.

Examples: Hibiscus, Bougainvillea and roses

Others special crops

□□□□□□□□□□□□□□□ • Sugarcane – for making sugar

□□□□□□□□□□□□□□□ • Tobacco – for making cigarettes

(b) Morphological classification

This is a way of classification done according to the seed Morphology in terms of Cotyledons.

(i) Monocotyledons: are crops whose seed have only one cotyledon

Characteristic

□□□□□□□□□□□□□□□ • Narrow long leaves with parallel veins

□□□□□□□□□□□□□□□ • Fibrous not system

□□□□□□□□□□□□□□□ • One cotyledon

Example: Cereals e.g. maize, sorghum, millet etc

(ii) Dicotyledons: are crop with two (2) cotyledons

Characteristic

□□□□□□□□□ • 2 cotyledons

□□□□□□□□□□ • Broad leaved with net vein

□□□□□□□□□□ • Tap not

Example: legume e.g. beans, peas, groundnuts etc

(c) Classification according to life cycle

This classifies crops according to duration spent in the field with regard to life cycle of the plant.

(i) Annual crop

Are crops which complete their life cycle within one season (year) e.g. Beans, Peas, Potatoes

(ii) Biannual crops

This are crops whose life cycle is completed within two seasons (years), most of the vegetable e.g. onions, cabbage, etc

(iii) Perennial crops:

These are crops whose life cycle is completed more than one year e.g. coffee, tea, banana

(d) Use classification

This is a way of classification done according to their use or purpose

(i) Food crops: are crop plant grown for food

Examples: Cereal crops, legume etc

(ii) Cash crop plants, are crop plants grown for sale; Examples coffee, tobacco, pyrethrum, tea etc

(e) Vavilov's classification

Classify crops according to their origin;

Examples

Southwest Asia – barley, carrot, date palms, grapes, melon, wheat

Mediterranean – Cabbage, clover, hops, lettuce, oats, olive

Ethiopia – castor, coffee, finger millet, okra, sorghum, wheat, cow peas, cotton

Central – Apples, fox tail millet, hemp

S. East Asia – Bamboo, banana, Chinese yam, citrus, coconut, Coconut sugarcane

Indo-Burmese - Coco yam, cotton, garden egg, jute, mango pigeon pea, Rice

Chinese - Onion, orange, soya bean, peach, tea

W. Central Africa - Barbara groundnut, coffee, kola, cow pea, sorghum, Oil palm, red rice, yam

C. America, Mexico - Guava, kidney bean, maize, red pepper, sisal, up land Cotton

Ecuador palm - Avocado, peer, potato, pawpaw, sea bland cotton,Sweet potatoes, tobacco, tomato

Brazil, Paraguay - Cashew, cassava, cocoa, groundnut, pineapple, Rubber

Knowledge of the origin of a crop enables plant breeders Identity diverse forms of the species from which useful traits or characters can be obtained for use in crop improvement programmers.

DISTRIBUTION OF MAJOR CROP PLANTS OF ECONOMIC IMPORTANCE IN TANZANIA

FACTORS AFFECTING CROP PRODUCTION IN TANZANIA

There are five groups of factors which affect crop production in Tanzania. Those groups of factors are as follows;

a) Climatic factors

b) Edaphic factors

c) Biotic factors

d) Economic factors

e) Social factors

A. Climatic factors

The include temperature, rainfall, humidity, atmosphere pressure, wind direction and strength, sunshine and cloud cover. They are generally known as the elements of the weather.

Temperature

Depend mainly on the altitude of that area. Generally highland areas here lower temp, than lowland areas. (Threshold temp. minimum temp required)

Some crops grow well in areas with low temperatures others grow well in areas with medium or high temperature.

Rainfall

On the basis of their water requirements, plants are divided into three groups

Xerophytes

Are plants which grow well in very little moisture in the soil, they are also called drought-resistant plants.

Examples: Sisal, cassava and sweet potatoes

Hydrophytes

Are plants which grow well only in plenty of water in the soil. Example: Low land paddy

Mesophytes

Are plants which grow well only when there is neither too much water nor too little in the soil.

Examples: Maize, beans and cotton

Humidity

High atmospheric water vapour (humid), plant does not lose water easily through transpiration, hence encourages the development of fungus plant disease. Low humidity, retards the development of fungus plant disease, it also increase the rate of transpiration

Sunlight

Affects flowering in plants, the length of time during which plants are exposed to sunlight each day is called the Photo period
Some plants required exposure to long period of sunlight per day (long-day plants) in order to flower. Other require exposure for short periods each day (short day plants)

Wind

Affects the growth of plants. When plants are exposed to wind, they lose a lot of water through transpiration. Strong winds may also push down plants or break their branches to control strong wind it is necessary to provide (wind breaks).

B. Edaphic factors

Are characteristics of the soil, roots of plant grow in the soil, they absorb nutrient and water, for good plant growth soil must supply an adequate amount of nutrient, moisture and soil reaction or pH of the soil must be optimum as well as air supply.

C. Biotic factors

The growth of crop plants is affected by biological organisms. Insect nests and vermin attack crops and lower the yield. Plant disease also affects the growth and yield of crops plants. Weeds are plants which grow in a place where they are not wanted. They complete with crop plants for rooting space, nutrients and moisture.

D. Economic Factors

Most of the peasant farmers in Tanzania do not have enough money to buy inputs required for crop production e.g. cultivation equipments, such as ox-ploughs, fertilizer, improved seeds, pesticides and crop processing equipments.

Most of the rural areas of Tanzania here poor communications making distribution of input and transportation of products difficult.

E. Social factors

Most of the peasants in Tanzania do not possess good agricultural – know how. When some peasants are advised by agricultural extension agents on good forming practices, they do not easily adopt them for fear of risk.

Sometimes the farmers and their families are weak because they do not eat nutrition's food. Diseases and parasites also affect their health.

REMEDIAL MEASURES

Climatic and edaphic factors

(a) Mulching: Covering of soil surface with organic material to prevent

Evaporation looses and improves soil moisture and temperature.

(b) Fertilizer / Manure application to improve soil fertility

(c) Tillage: frequent land tillage will help plant roots penetration and improve Soil aeration.

(d) Liming:

Is the application of liming material (CaCo3), MgCo3) to acidic soil so as to bring soil into reasonable (PH) for plant growing. Describe level of soil (PH5-7.5) fertilizer may be used to raise soil acidity such as SA and CAN.

(e) Wind break

Tree can be planted around the farm to reduce the wind velocity so as to control wind effects.

(f) Irrigation

Watering of plants field in areas of low rainfall supply to reduce drought effects.

Biological factors

Field hygiene by proper and timely weeding, pest and disease control should be done as early as possible to reduce their effects on crops production.

Social economic factors

Provision of loan to enable farmers to have capital to invest in crop production.

Agriculture education – to improve extensions services so as to enable farmers to obtain skill and proper management practices in crop production.

Developments of research centre; to facilitate improvement of crop production through improve seeds, tools and management practices.

FARMING SYSTEM

Meaning of the concept: - This refers to the practices systems by which crops livestock can be used by farmers.

TYPES: There are three types

- Crop farming system
- Livestock farming system
- Mixed farming system

CROP FARMING SYSTEM

This refers to ways under which crops are grown. There are three types of crop farming System.

Subsistence crop farming: This is farming system whereby farmers produce food crops

Essentially for home consumption and surplus. Is either

Selling is done to meet domestic demands e.g. sugar, fuel etc.

Characteristic features of subsistence farming

Dependence on family labor: Subsistence farming activities e.g. Cultivation, weeding and harvesting.

Use simple technology: Farmers adopt simple farming technology to produce family food. Use of hand hoes axes, forked hoe. Ox – plough if available is practiced

Small farm size: Fields are usually small less than far family. The farms are usually fragmentary into small pieces for growing different. food crops.

Standard of living: In subsistence farming areas, the standard of living of most farmers is very how.

Important services such as transport, communication and developed market infrastructure are lacking.

Poor method of farming method Inter cropping is a common practices in subsistence Agriculture, even though yields are always low due to poor techniques.

Dependence on areas as food crops.

Important crop crops grown in this system is largely cereals, maize, sorghum, millet paddy, as well as not crops, and groundnuts and bananas.

ADVANTAGES OF SUBSTANCE FARMING.

• Many crops can be grown

• Control protect soil fertile due to many crop grown in one area inter cropping

• Production for hone consumption serves transport and marketing.

• Food sufficiency for domestic and local demands

• Farmers are kept independent of the market

• It is more adaptable to price fluctuation.

Disadvantages of substance farming

• Small scale production tend to keep farmers poor

• Difficult to provide extension services as farmers are scattered

• Labor becomes redundant between harvesting and planting time when there is nothing to do.

• As more labor and other units of Inputs are added to increase output. yields always become low (the setting of law. of law of diminishing returns

• Low economic development due to low investment survival of the farms is threatened by extent. of crop failure since they reduce small samples over and above the family nutritional requirement

Arable farming: This is the growing of short term crops in arable land where animal crops are grown.

• Can either be practiced by shifting or salted utilization system.

Characteristic feature of Arable farming.

• Large scale field of about 1- 1oo hectare. With animal crop like wheat, barley plantation.

• Uses Improved tools, seeds, fertilizers, Chemical as well

Characteristic feature of Arable farming.

• Large scale field of about 1-100 hectare with annual crops like wheat, barley plantations.

• Uses Improved tools, seeds, fertilizers, chemical as well

Characteristic feature of arable farming

- Large scale field of about 1-100 hectare with annual crops like wheat, barley plantations
- Use improved tools seeds, fertilizers, Chemical as well as ox power or tractor power
- Crop rotation system practiced to allow replenishment of soil fertility
- Crook crop husbandry.

Advantages of Arable farming system

• Supply enough food for the society nation

• Help to Improve and maintain land soil fertility

• High saving is achieved due to high income gained

• Both cash and food crops plants are produced thus supplying raw materials to local industries

• Foreign exchange earner

• It helps to more population to get involved in agriculture.

Disadvantages of arable farming system

• Need large area of land (1-100hectare)

• High capital Investment for buying input and Machinery

• Need skilled labor to operate the project

• It depended mainly on rainfall, as poor Weather causes great loss

Commercial crop farming it involves growing of crop for commercial purposes either

Small or large scale production

ADVANTAGES OF COMMERCIAL FARMING

• It generates foreign money in the country from the selling or exporting leading crops e.g. coffee, tea sisal.

• Create employment opportunity through local Industries which uses raw materials from crops grown.

• Make use of poor marginal areas with scare rainfall not stuffiest to support meaningful crop farming.

CROPPING SYSTEMS AND PLANTING PATTERN

Various cropping system are used by farm grow their crops, using various patters.

Cropping system: Is a combination of crops which are grown by farmers in a Particular season.

Planting pattern: Refer to the Method by which the crop are planted in the CROPPING SYSTEM.

(i) Monocroping;

Is a practice of growing one type of any annual crop on a field in seasons

(ii) Monoculture:

(Pure stand cropping) is the practice of growing the same crop on a particular field for a long period of time e.g. coffee, tea.

(iii) Advantages of (i) & (ii) systems

The system enable farmer to apply fully the recommended cultural practices because on type of crop is grown at a particular season.

Disadvantages of (i) and (ii)

- Risky system as only one crop is grown at a time; any crop failure due to bad weather, pest and diseases outbreak the farmer is likely to end up with poor harvest.

- Facilitates poor soil fertility due to continuous depletion of the martens by the same crop yearly thus resulting to low yield in subsequent seasons.

- Risk of increasing population of certain weeds pests and disease due to the effect of specific biological organisms to a particular hosting to low yield in subsequent seasons.

Crop rotation:

This is the process of growing different types of crops on the same piece of land in successive seasons or years.

Factors/Principles to be considered when planning a rotation

1) Feeding habit of plants,

There are some crops which utilize/absorb only a small quantity of nutrient (Light feeders) while others absorb a lot of nutrients (Heavy feeders)

Hence, if is advisable to interchange heavy feeder to light feeders when planning a rotation

2) Rooting system
Some plants have short fibrous roots which occupy mainly the upper surface of the soil (shallow rooted) while others are deep rooted (Deep rooted)

- To maximize benefit from the soil, it is advisable to alternate deep rooted with shallow rooted crops, when planning a rotation

3) Families

Plants of the same family members are attacked by the same disease microorganisms and pests. It is advisable to plant different families in successive seasons.

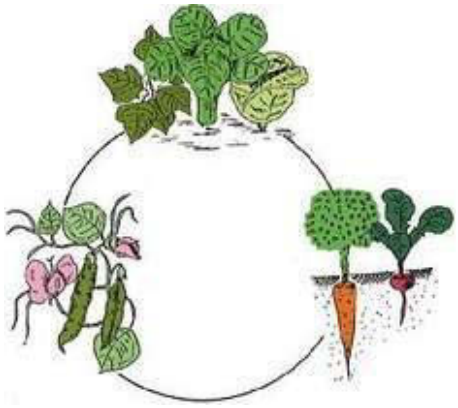
4) Growing habit

Different growing habits e.g. sweet potatoes, pumpkins, cover the soil fully than maize or sorghum thus surprising weeds. It's advisable to include such plants in the rotation

5) Improvement of soil fertility, it is advisable to include leguminous plant in the rotation so as to improve soil fertility through nitrogen fixing bacteria.

Examples of crop rotation

(a)



(b)

Cycle	Plot1	Plot2	Plot3
1st Year	Cotton	Beans	Maize
2nd Year	Bean	Maize	Fallow
3rd Year	Maize	Fallow	Cotton
4th Year	Fallow	Cotton	Beans

Advantages

- Helps to control insect pests, diseases and weed
- Provides full utilization of soil nutrients by plants
- Improves soil fertility when legumes are inclusive

Interpolating

This is the practice of growing two or more types of crops at the same time / season.

Types

(i) Inter cropping

Is a practice whereby different crops which are planted at a specific and systematic pattern.

(i) Mixed cropping

Is a practice where by different types of crops grown are planted randomly in the field.

Advantages

- Roots of different crops grow fill up in the soil profile fully than only one type of crop is grown
- Shallow rooted crops absorb water and nutrient from the upper layer.
- Deep rooted absorb water and mineral from deep layers
- When leguminous crop include improves nitrate content in the soil
- Help to control soil erosion due to full soil coverage which protect the soil surface from water and wind erosion
- Ensures protection against crop failure i.e. when one crop fails a farmer can harvest other crops

Planting patterns

Farmers in different areas use different planting patterns

Types

(i) Broadcasting

(ii) Row planting

(iii) Drilling

(1) Broadcasting

This is a random scattering of seeds over the surface of the field

□□□□□□□□□ • This can either be done by hand or machine i.e. Broadcaster

□□□□□□□□□ • Seed covering in either a separate operation or not don at all

Disadvantages

□□□□□□□□□□□ • Difficult to estimate seed rate

□□□□□□□□□□□ • Seed coverage is poor

□□□□□□□□□□□ • Other post planting operations e.g. weeding cannot be carried out

□□□□□□□□□□□ • Sometimes thinning is require

(2) Row planting

This is a systematic planting of seeds in well spaced rows systematic distances

□□□□□□□□□□□ • Can be done either by hand or machine (row planters)

□□□□□□□□□□□ • Distance between rows is known as inter-row spacing

□□□□□□□□□□□ • Distance between plants is known as intra-row spacing or within now spacing

(3) Seed drilling

This is a random dropping and covering of seed in furrow to give definite rows

Comparison between Broadcasting and Row planting

i. Broadcasting is used when growing close growing crops e.g. pasture grass, paddy, while row planting is used for widely spaced crops e.g. maize

ii. When row planting is used correct spacing can be done, thus optimum plant population is obtained leading to high yield

iii. It's possible to do machinery operation like weeding, fertilizer application, spraying and harvesting when row planting is practiced, compared to broadcasting.

GENERAL PRINCIPLES OF FIELD CROP PRODUCTION

Major principles of crop production (annual crops) fall under two categories

(i) Pre-harvesting operations, these are practices or operation which are done before the crops reaches maturity and ready for harvesting.

(ii) Post-harvesting operation

Refers to all practices geared at the handling of the crops produce after harvesting

Pre-harvesting operation

The following practices or operations are inclusive

(a) Site selection:

A choice of a good site is important

- Site should have the following quality
- Well drained soils of good fertility
- Easily accessible for easy transportation of input and harvests
- Well protected from strong and vermin

(b) Land preparation; this involves the following operation

- Clearing of bush and removal of stamp
- Opening up the soil (i.e. tilling the land) by plowing
- Loosening of soil ambles (if machinery was by harrowing
- Removal and burning of trashes

(c) Planting

This involves the following

- Selection of suitable seed variety is suitable for planting in an area with preferred ecological condition. Select recommended for planting in your area
- Dressing of the seed if the seeds have not been dressed. This is done to control soil born diseases and pest-from attacking the seeds after planting.
- Selection of suitable planting time. Usually early planting is recommended to avoid pests and diseases as well as full utilization of early rains.

e.g. Sometime crops require dry weather at maturity e.g. legumes or wheat. To avoid unfavorable. Weather during maturity proper planting period should be selected.

For cotton, maize, sorghum, pyrethrum etc early planting is recommended to avoid low yields.

Weeding

To avoid competition of plant and weeds, timely weeding is essential. This can either be done by hand, machine or chemical (i.e. use of herbicide). The operation should be done when the plants are still young and tender

Fertilizer / Manure.

For increase in yield, use manure is very important; especially right after weeding. Application of suitable nitrogenous fertilizer e.g. SA, CAN and UREA according to recommendations of the ministry of Agriculture.

Thinning

This is the removal of excess / weak plants and leaves the required number of plants / heel to reduce competition as well as facilitate the recommended spacing for optimum yield.

Pruning

In such a crops like tobacco, where tips of Tobacco leave in the nursery are cut by sharp pruning tools to reduce speed of growth, to make stem strong as well as hardening off seedling for field condition.

Topping/Desuckering

(Tobacco) these operations are exercised in tobacco plant to get large leaves and desuckering is the removal of sucker from tobacco plant between stem and leaf. Preparation of storage unit / cribs

(j) Harvesting: The operation should be timely done, when the crop has reached its maximum maturity period.

- Proper handling of the crop during harvesting is quite essential.

- Harvesting equipments should be clean and dry to reduce risk of destroying the harvest.

- Quick transportation of the harvest from the field to homestead should be done to avoid theft and crop destruction by insects or untimely rain showers. Post harvest

Operations include the following:-

(a) Further Drying: Low moisture content especially in cereal crops facilitate long and safe storage. Further drying after harvesting is essential.

(b) Fumigation/Dressing: When the harvest is dry and to ensure safety in ware houses/stores, fumigation by spraying the produce before bagging and after or Dressing by dusting with storage chemicals can be done.

(c) Storage: This is the final operation. The following should be considered:

- Stores should be well ventilated to provide good aeration thus reduce insect multiplication.

- Windows should be protected with wire mash to control insects from entering.

- Bags should be stacked on raised pallets.

- The floor should be dry and protected from any water entrance.

- Frequent cleaning of the store should be done.

- Rodents should be well taken care of.

INTRODUCTION TO LIVE STOCK SCIENCE AND PRODUCTION

THEME 04 : INTRODUCTION TO LIVESTOCK SCIENCE AND PRODUCTION

LIVESTOCK: This is the term representing all domestic animals and birds of economic importance.

- These include cattle, poultry, pigs, sheep, and goats.

LIVESTOCK PRODUCTION: Is the art and science of keeping livestock.

CLASSES OF LIVESTOCK KEPT IN TANZANIA AND USES:

(i) Cattle; for the supply of milk, meat, and skin (hide).

-Milk cattle are known as dairy cattle.

-Meat cattle are known as beef cattle.

-Cattle producing both milk and meat are called Dual purpose cattle.

-Those cattle used as drought animal are called oxen.

(ii) Poultry; for the supply of eggs and meat.

-Poultry for eggs are called layers.

-Poultry for meat are called broilers.

-Those suitable for both are called Dual Purpose poultry.

(iii) Pigs; for the supply of meat and fat.

(iv) Sheep; for the supply of wool and meat (mutton).

(v) Goats; specifically kept for meat and milk.

CATEGORIES OF LIVESTOCK.

(i) Indigenous/local.

(ii) Exotic type.

General characteristics of local and exotic type of livestock.

(i) LOCAL TYPE.

- Mature live weight is small.

- Found mostly in Tropical Temperature lying between (150– 300C).

- Highly heat tolerant.

- Low yield of meat, eggs, wool, etc.

- Disease tolerant.

Low pasture nutritive value: Most of the tropical grass grows very fast during wet season, thus

Construct very low nutritive content compared to temperate are. This in town cause poor animal health due to poor nutritive value resetting to poor yield.

Presence of harmful organism, parasites, vectors: High temperatures with low relative humidity experience in Tanzania: saves as a good breeding / reproduction for this the productivity.

SOCIAL ECONOMIC FACTOR

i. Traditional among livestock keepers. Poor livestock husband as experienced through

use of traditional methods by different livestock keepers. egg. Keeping for prestige time the social needs etc: thus causing over storing of animals without considering availability of pas the animals, resulting to low yields.

ii. Lack of specialization: production with specialization is high effect and economical – e.g. cattle- For meet only for meat only (beef). This is because, there will be letter management resulting to letter performance.

iii. Lack of capital entail capital in livestock production investment is quite high for purchasing of tolls equipment

- purchase of good breeds
- Purchase of drugs
- Construction of water supply dams housing
- Purchase of improved pasture seeds e.t.c.

Hence enough capital is needed lack of which may cause poor production.

iv. Poor technology: Proper feeding, breaching and disease and pest control require proper skills of high most keepers do not have.

Institutional factor: this include the following:-

• Inadequate support services: This involves poor extension service.

• Inadequate technical and research centers for livestock production in Tanzania.

Shortage of suitable livestock breeds, feeds, veterinary drugs and other inputs.

HOW TO OVERCOME THE PROBLEMS

• Provision of credit facilities: So as to encourage livestock keeping and through loan provision.

• Improve extension services and veterinarians to convey livestock technology from research centers.

• Improving livestock input supply e.g. feeds, pasture sees drugs etc.

• Social and traditional taboos discouraging development of livestock production should be discouraged.

LIVESTOCK FARMING SYSTEMS

Meaning is there are systems used to raise livestock types.

i. Free range

ii. Intensive

iii. Semi Intensive.

Free range: This is as system whereby animals are left to find their feed weather freely in the day and are locked in a house in the night sometimes called extensive system

It is commonly used in poultry farming and sometime goats and sheep.

Characteristic features: Stock number is very low compared to the large area of land used.

The animals not receive little or extra feed eating only insects grass and other feed available. Little disease prevention animal growth.

Advantage

i. Low initial capital to start with.

ii. no feed costs ass animals feed in their own

iii. Cheap or small house can be used to shelter the animals

iv. Animals get a lot of exercises as they move extensively.

Disadvantage.

i. Large space is needed to allow animals to loiter and find food

ii. May cause damage to people's properties e.g. crops while in see for food.

iii. Low safety to animals as they can be stolen, eaten by predation or knocked by passing cars or bicycles.

iv. High exposure to adverse weather e.g. coldness rain a well as exposure to parasites, vectors and diseases.

v. It is difficult to collect – eggs

vi. Lives weight of the animals is very low due to too much walking.

Intensive: This is a system whereby animals are confined in well controlled environment e.g. house or fence and feeding is done inside.

Advantages: Large number of animals is kept on a small area of land.

i. Provide safety to animals as they are enclosed within a how is fence.

ii. Easy provision of extra feed

iii. Animals receive great attention on disease/ peck control

iv. Protection against weather

v. Possible to have records of each animal so as to facilitate breeding.

vi. Easy to collect.

Characteristics: A Large number of animals are kept in a small area of land

i. Animals are kept in the fence or house.

ii. Extra feed is provided.

Disadvantages: High skill is needed to operate the system e.g. disease control. and housing requirement.

High initial capital is needed for construction of houses dope water sources e.t.c

High feed cost.

Semi Intensive:

Is sputum whereby animals are partially confined during the night and during the day they are released for feeding within a fence.

Features /Characteristics.

A house constructed at the centre of a fence. Presence of paddocks where animals feed

Water troughs are found within the feeding areas.

Advantages

Simple and cheap house can be constructed live reduction of feed costs as animals can be left to grain fetid of the forced house. Animals can be attended.

Disadvantages.

Number of animals is limited due to constriction cost of houses and paddocks.

PRINCIPLES OF LIVESTOCK PRODUCTION

Involve the following

- Breed selection
- Feeding
- Housing
- Pests parasites / Disease control
- Stock man

Breed selection

Meaning: This is a process of choosing particular animals from assorted collection of animals. As parent of future generation.

- Traits which are observed include
- Best milk producers
- Best meat produces.

Method of selection

• selection basing on physical appearance

• selection basing on animal records n individual performing

• selection index basing economic importance of each trait, heredity

Importance of Breed selection

• Facilitate selection of animals of better quality and quality products e.g. wool, Milk and meat.

• Facilitate selection of disease resistant animals.

• Facilitate selection of disease resistant to subjected climate e.g. jersey can resist tropical climate while Frisian common pawpaw Breed suited to semi aid areas of.

• Resistance to high ambient temperatures and today conditions.

Selection time

After full maturity of animals, as the physical characteristics can easily be seen.

Feeding: This refers to the supply of food of balanced duet to animals of different classes, and at different ages.

Suitable feeding periods

The suitable time for feeding animals depends mostly on body requirement such as:

• Body maintenance

• Growth stage

• Reproductive stage

• Production stage – e.g. Milk, eggs, meat , fats or wool

Types of feeds suitable for different classes of animals.

a) Concentrates: there are feed types which have moisture content bull with high mutative. e.g. protein concentrates – cotton, sunflower, groundnuts cakes, fish meats.

• Energy concentrates – cereal grains and their production e.g. maize bran, rice bran etc

• Concentrates are the main source of food for non- ruminant animal's e.g.

Pigs and poultry, while other animals are given as supplementary.

b) Roughage: These are high fiber content feeds e.g. pastures grass, straw and hay.

• Hay is one form of roughage which is a major food stuff for ruminant animals e.g. cattle, goat, sheep etc, because they have special bacteria which break the cellulose.

Try roughage are-hays (e.g. legume and grass), Trans (wheat, barley, orts) food ad stoker

IMPORTANCE OF PROPER ANIMAL FEEDING

(a) To facilitate fast growing

(b) To facilitate good animal health so as to provide disease resistivity

(c) Facilitate increase of animal fertility and production

(d) Optimize production level of animal products e.g. wool, eggs etc

(iii) Housing: This is the provision of shelter to farm and so as to protect animals from

- Bad weather e.g. cold, rain or sun
- Predators e.g. snakes etc
- Thieves
- Insect pests e.g. Tsetse flies, ticks etc
- The building should have a slight slope to facilitate water draining; as well as provision of concrete floor suitable roofing material should be used to prevent animals from rain and sunshine.

- If possible in a cattle house, bedding materials e.g. grass straws should be provided and changed regularly. Poultry house can also be provided with bedding's.
- The building should be well ventilated to provide with bedding
- The building should be well ventilated to provide goods aeration
- Feeding and water drinking facilities should be provided in a good number to reduce sightings.

(iv) Diseases & Parasites

Healthy: This is a normal, effective and proper functioning of the body parts of an

animal.

Parasites:

These are organisms which derive all its nourishment from another organism (Host) while the host does not benefit from the association e.g. worms, ticks microorganisms etc.

Host:

This is the organism which gives support or living hood to the parasite and then suffers the disease

Control of animal Diseases

This can be done either

(a) Directly:

This involves provision of cure when the disease has already established this is done by treating the animals with drug

(b) Indirectly:

Prevention and control of animal diseases

People who own or keep animals are responsible for their care and health. The Government has set a number of rules to monitor the health of kept animals. These rules largely concern the prevention, monitoring and control of animal diseases.

The Government has also set specific rules for a number of animal diseases, for example because of their potential social and economic impact or because they pose a threat to human health.

Prevention of animal diseases

• To prevent the introduction and dissemination of animal diseases as far as possible, owners of animals must (among other things):

• Do their best to keep animal diseases out of their business;

• Ensure adequate hygiene;

• Be alert to symptoms of disease;

• Comply with requirements when importing animals from other countries;

• Notify a vet of any suspected animal disease.

• When there is an increased risk of infectious animal diseases entering the country, more stringent supervision of animal transports is applied. These measures can be at farm or national level (e.g. a ban on imports from infected countries).

Travelers

There are some holiday destinations where infectious animal diseases, such as foot and mouth or bird flu, are prevalent. The Government therefore advises travelers to be careful about contact with animals abroad. Pathogens from these animals can be accidentally introduced into the Netherlands with travelers and their luggage.

Notifiable animal diseases

Stricter rules apply to certain animal diseases in terms of reporting, identification and control. When such diseases are notified the Ministry of livestock can announce additional control measures. The reasons for requiring notification of such animal diseases are as follows: They can spread quickly;

They can cause serious damage to the species in question;

They cannot be prevented or controlled by normal commercial methods; They present a serious threat to public health.

Animal diseases can also be designated as notifiable under international conventions.

Reporting animal diseases

If an animal shows symptoms of a notifiable animal disease, the owner, vet or laboratory must notify the authorities by telephoning the national desk for animal diseases:

Highly infectious animal diseases

The State is required to combat certain notifiable animal diseases. That means that the Government must always take measures to counter the spread of such diseases.. These animal diseases are treated in accordance. Which are elaborated in the national policy scenarios of the Ministry of Economic Affairs. The approach is regulated in various scenarios.

Other preventive and curative measures of livestock diseases

Isolation; Is the separation of diseased animals from fro the health ones from infectious diseases

Quarantine; Are measures aimed at preventing movement of animals in or out of infected areas. Usually the police are informed.

Destruction of disease vectors e.g. Tick, tsetse fly by destroying their breeding areas, chemical spraying, and bush clearing.

Prophylactic measures; this is a drug control measures practiced on routine drenching at a 4 week interval.

Slaughtering; in case of high infectious disease such as FMD, slaughtering is done. Vaccination; Is an artificial way of giving immune to a particular disease, it involves injecting animals with preventive drugs

STOCK MAN; Is one who keeps the animals.

Quality of a good stock man ship

• Should be kind to the animals by avoiding beating, pulling their ears and twisting their tails or torturing them.

• Must know their daily and monthly routine operation very well e.g. when drenching, spraying, dipping, vaccination e.t.c.

• Should be up to date of production records breeding accounts e.g. in order to find a change and act upon it.

• Have knowledge of disease and reproduction of farm animals

Mixed farming is an agrarian system that mixes arable farming with the raising of livestock contemporaneously. When on a farm along-with crop production, some other agriculture based practice like poultry, dairy farming or bee keeping etc. is adopted, and then this system of farming is known as mixed farming. It is the dominant system in Europe and now in parts of India, where most farms have a mixture of fields and pastures.It was first mainly used for self-consumption, but now in advanced countries like USA, Japan, etc., this is done for a commercial purpose

For example, the same farm may grow cereal crops, and keep cattle, sheep, pigs or poultry.

In mixed farming, along with farming some other agriculture based practices are also carried out. Often the dung from the cattle is used to fertilize the cereal crops. Before horses were used for haulage, many young male cattle were often not butchered as surplus for meat but castrated and used as bullocks to haul the cart and the plough.

Advantages

i. Animal and crop benefit from each other (mutual benefit) whereby plants provide animal feed and animal provide

ii. Balance diet from plant and animals products improve farmer health

iii. Continuous cash flow is realized

iv. Animal feases can be used in biogas processing for electricity production

Disadvantages

• High labor is needed in running both projects

• Only cofined in areas where both animals and crops can be reared effectively.

• High level of technology is required in managing crops and various types of animals

• Inefficient production due to diversification.

FARMING BUSINESS ECONOMICS AND AGRICULTURAL EXTENSION

THEME 05: FARMING BUSINESS ECONOMICS AND AGRICULTURAL EXTENSION

Agricultural economics (agronomic) is an applied field of economics concerned with the application of economic theory in optimizing the production and distribution of food and fiber — a discipline known as agronomic. Agronomic was a branch of economics that specifically deal with land usage. It focused on maximizing the crop yield while maintaining a good soil ecosystem. Throughout the 20th century the discipline expanded and the current scope of the discipline is much broader. Agricultural economics today includes a variety of applied areas, having considerable overlap with conventional economics. Agricultural economists have made substantial contributions to research in economics, econometrics, development economics, and environmental economics. Agricultural economics influences food policy, agricultural policy, and environmental policy

Importance of agriculture economics

• Agriculture economics enable farmer to know the cost involved in production of a particular farming programmed

• To enable the farmer to know the returns or benefit this will be obtained from the programmed.

Objectives

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• To enhance students' acquisition of the understanding of basic natural science concepts in agriculture.

• To enhance students' comprehension of agricultural science concepts, principles, theories and skills in crop production, livestock production, and soil management, fisheries and renewable resources.

• To inculcate in students fundamental principles, theories and knowledge in all branches of agricultural economics including production, farm management, marketing, policy and development, finance, project monitoring and evaluation

• To equip students with skills to work in an interdisciplinary environment and collaborate with technical scientists in developing new technologies that improves yield, nutritional qualities, storage values and various prototype equipments for agro –businesses;

• To equip students with skills for carrying out economic analysis, feasibility studies, establishing appropriate monitoring and impact assessment mechanisms for Local, States and Federal governments, NGO's , and international agencies;

• To equip students with relational skills that can strengthen linkages with private and public enterprises.

• To make our research finding available to local, national and international communities

BRANCHES OF AGRICULTURE ECONOMICS

A. Production economics; this is a branch of economics dealing with the production of a particular farm project. It involves the use of several resources called INPUTS to create or produce goods and services called OUTPUTS.

B. Agriculture marketing; this is the performance of all business activities that are involved in the flow of agriculture goods and services from the area of production to the consumer.

C. Farm management; this is a branch of economic which involves the study of using the scarce resources available in different ways and combination to produce different items.

D. Economic concepts; this is the study of production distribution and consumption of goods and services.

E. Rural sociology; these deals with social aspects of rural community i.e. customs, norms and tradition of the farmers

The Importance of Agriculture

For decades, agriculture has been associated with production of essential food crops. At present, agriculture above and beyond farming includes forestry, dairy, fruit cultivation, poultry, bee keeping, mushroom, arbitrary, etc. Today, processing, marketing and distribution of crops and livestock products etc. are all acknowledged as part of current agriculture. Thus, agriculture could be referred to as the production, processing, promotion and distribution agricultural products. Agriculture plays a critical role in the entire life of a given economy. Agriculture is the backbone of economic system of a given country. In addition to providing food and raw material, agriculture also provides employment opportunities to very large percentage of population. Below are the importance of agriculture:

Source of Livelihood
The main source livelihood of many people is agriculture. Approximately 70 % of the people directly rely on agriculture as a mean of living. This high percentage in agriculture is as a result of none development of non-agricultural activities to absorb the fast growing population. However, most people in developed countries do not engage in agriculture.

Contribution to National revenue
Agriculture is the main source of national income for most developing countries. However, for the developed countries, agriculture contributes a smaller per cent age to their national income.

Supply of Food as well as Fodder
Agricultural sector provides fodder for domestic animals .Cow provides people with milk which is a form of protective food. Moreover, livestock also meets people's food requirements.

Significance to the International Trade
Agricultural products like sugar, tea, rice, spices, tobacco, coffee etc. constitute the major items of exports of countries that rely on agriculture. If there is smooth development practice of agriculture, imports are reduced while export increases considerably. This helps to reduce countries unfavorable balance of payments as well as saving foreign exchange. This amount may be well used to import other essential inputs, machinery, raw-material, and other infrastructure that is helpful for the support of country's economic development.

Marketable Surplus
The growth of agricultural sector contributes to marketable surplus. Many people engage in manufacturing, mining as well as other non- agricultural sector as the nation develops. All these individuals rely on food production that they might meet from the nation's marketable surplus. As agricultural sector development takes place, production increases and this leads to expansion of marketable surplus. This may be exported to other nations.

Source of Raw Material
The main source of raw materials to major industries such as cotton and jute fabric, sugar, tobacco, edible as well as non-edible oils is agriculture. Moreover, many other industries such as processing of fruits as well as vegetables and rice husking get their raw material mainly from agriculture.

Significance in Transport
Bulks of agricultural products are transported by railways and roadways from farm to factories. Mostly, internal trade is in agricultural products. Moreover, the revenue of the government, to a larger extent, relies on the success of agricultural sector.

Foreign Exchange Resources
The nation's export trade depends largely on agricultural sector. For example, agricultural commodities such as jute, tobacco, spices, oil seeds, raw cotton, tea as well as coffee accounts for approximately 18 % of the entire value of exports of a country. This demonstrates that agriculture products also continue to be important source of earning a country foreign exchange.

Great Employment Opportunities
Construction of irrigation schemes, drainage system as well as other such activities in the agricultural sector is important as it provides larger employment opportunities. Agriculture sector provides more employment opportunities to the labor force that reduce the high rate of unemployment in developing countries caused by the fast growing population.

Economic Development
Since agriculture employs many people it contributes to economic development. As a result, the national income level as well as people's standard of living is improved. The fast rate of development in agriculture sector offers progressive outlook as well as increased motivation for development. Hence, it aids to create good atmosphere for overall economic development of a country. Therefore, economic development relies on the agricultural growth rate.

Source of Saving
Development in agriculture may also increase savings. The rich farmers we see today started saving particularly after green revolution. This surplus quantity may be invested further in the agriculture sector to develop the sector.

Food Security
A stable agricultural sector ensures a nation of food security. The main requirement of any country is food security. Food security prevents malnourishment that has traditionally been believed to be one of the major problems faced by the developing countries. Most countries rely on agricultural products as well as associated industries for their main source of income.

Challenges facing Tanzania food systems

Each day – all around the world – farmers face the same common threats to their productivity and livelihood. In Africa, however, the challenges go beyond damaging weather, pests and disease. And, with 80 percent of Africa's farmers cultivating less than two hectares (five acres), getting to know small-scale farmers is essential to understanding the hurdles facing the continent's food system.

As Africa's population grows from 1.1 billion to an estimated 2 billion by 2050, what critical factors will need to be overcome?

1. Critical inputs

Farmers at all scales of production need access to the inputs required to produce a successful crop – high-yielding seeds, effective fertilizer and sufficient water. Even when these are available, input pricing is often too high for smallholders – resulting in fertilizer use in Sub-Saharan Africa of just one-tenth the world average.

2. Access to financing

Challenging legal and financial environments are constraining growth in African agriculture. For smallholders, especially, credit is often inaccessible or unaffordable. Without appropriate financing, farmers are not only less able to invest in their operations but also much more vulnerable to market volatility and unpredictable weather.

3. Property rights

According to the Food and Agriculture Organization (FAO) of the UN, secure land tenure and property rights can drive poverty reduction, rural development and global food security in developing countries. Farmers with clear land ownership are motivated to reinvest in their operations and increase production beyond subsistence farming, selling the surplus. Yet in many parts of Africa, farmers are unable to own their land and pledge it as collateral, limiting their incentive to reinvest in their businesses.

4. Infrastructure for market access

Farmers generally can earn higher prices outside of harvest season – yet few African smallholders have access to proper storage to take advantage of price fluctuations. Furthermore, many smallholders live in isolated, rural areas. Infrastructure like paved roads, reliable energy, warehouses and cold storage not only benefits farmer livelihoods but improves food security by reducing post-harvest loss. According to FAO, 40 percent of the population in Sub-Saharan Africa lives in landlocked countries, versus just 7.5 percent in other developing countries. That means farmers in this region require greater access to primary cross-border markets – access that is made slow and costly by poor roads, long delays at borders and other issues.

5. Off-farm income

It may sound counter-intuitive, but off-farm income is critically important to agricultural development. The first migrants from farms to cities often send money back to their family members. Those remittances can fund better farm inputs – seed, fertilizer and machinery, for example. The resulting improvement in productivity enables more people to leave the countryside for cities where their incomes, and their diets, tend to improve – boosting demand and prices for farm output. In short, farmers and farm output benefit when urban workers have incomes sufficient to purchase food at prices that encourage farmers to produce more.

Agriculture, industry, and their inter-relationship

All industries which uses agriculture raw material are known as Agro-industries; and industries which provide inputs for agriculture production are known as Agriculture Related Industries

The contribution of agriculture development to industrial development to industrial development; Normally, the agricultural sector of a country has to improve before the industrial sector improves.

Hence the developments of agriculture help the following,

1. Agricultural development allows the agriculture sector to release part of its labour force of which can be employed in the industrial sector.

2. Agriculture development saves foreign exchange. Through reduced importation of food of which can be used to buy industrial goods and raw materials.

3. Agriculture development increases the total income of farmers, through selling of surplus to urban population and thus increases farmers purchasing power of industrial good.

4. Agricultural development increases government revenue, through taxation of the income above subsistence level of which can be used to finance various industrial development projects.

5. Agriculture development stimulates the formation of raw marketing firms, through increased transportation, agriculture processing industries, storage firm, distribution firms e.g. The contribution of industrial development to agricultural development

• Industries increase urban workers income, this in turn increase food demand, thus creating a ready market for agriculture product

• Industries create employment, through absorption of surplus labour from the agricultural sector, thus improving the standard of living of both rural and urban people.

• Industries create urban areas, through increased migration of rural people to areas with industries, thus increasing industrial population.

SOIL AND ITS AGRICULTURERAL UTILIZATION

THEME 06 : SOIL AND ITS AGRICULTURERAL UTILIZATION

Soil originates from Latin word “solum” meaning floor. Thus it’s a natural consolidated material that originates from weathered mineral rock and decomposition organic matter which supports plant and animal life.

Importance of soil to agricultural production

• It is a natural medium within which seeds germinate and roots grows

• It supplies plant with the mineral nutrients necessary for crop growth

• It provide anchorage for higher plants

• It provide water, air, and warmth for small small animals, microorganisms and plant roots to sustain life

• It shelters many small animals and microorganisms within the top soil

COMPOSITION OF SOIL

Soil is a complex body composed of five major components:

• Mineral matter obtained by the disintegration and decomposition of rocks;

• Organic matter, obtained by the decay of plant residues, animal remains and microbial tissues;

• Water, obtained from the atmosphere and the reactions in soil (chemical, physical and microbial);

• Air or gases, from atmosphere, reactions of roots, microbes and chemicals in the soil

• Organisms, both big (worms, insects) and small (microbes)

Mineral matter

According to its size, soil can be separated into various fractions. Two common systems of classification are given in Table I.

Table I.: Classification of soil particles according to two systems (U.S.D.A and International)

Soil separates	U.S.Dept.of Agric. System Diameter(mm)	International system diameter (mm)	Number of particles per g
Very coarse Sand	2.00-1.00		90
Coarse sand	1.00-0.50	))2.00-0.20)	720
Medium sand	0.50-0.25		5,700
Fine sand Veryfinesand	0.25-0.10 0.10-0.05	))0.20-0.02)	46,000 722,000
Silt	0.05-0.002	0.02-0.002	5,776,000
Clay	below 0.002	below 0.002	90,260,853,000

Formation of mineral matter

1. Primary minerals are formed at high temperature during cooling and crystallization of magma, they are inherited from rock materials and have not been altered chemically and they range above 2mm in diameter e.g. quartz.

2. Secondary minerals, formed at ordinary temperatures and chemically alteration of rock and mineral precipitation of the weathering e.g. clay.

Importance of mineral matters

Contain plant nutrients for growth i.e. Macro nutrient and Micro nutrient. Examples of Macro nutrients are Calcium (Ca), Magnesium (Mg), Potassium (K), Sulphur (S), Phosphorus (P) and Nitrogen (n). Examples of micro nutrient are Copper (Cu), Zinc, Molybdenum (M), Chlorine (Cl.), Boron(b), Manganese(Mn), Iron(Fe) and Cobalt (Cb).

Organic matter

The organic matter of the soil is an active state of decomposition caused by soil microorganisms. These are farmed from two components;

1. Plant residues; These include plant tops, plant roots, shrubs, grass, plant debris, crop harvests, green manure and compost manure.

2. Animal residues; these include worms, insects, bacteria, fungus, algae, animal manure. The organic matter of the soil is in the soil, the process of breaking down the remains is known as decomposition.

Importance of organic matter

• Act as mulch; before decomposition it can act as mulch, by covering the soil surface hence reduce the rate of evaporation, impact of rain drops and check in water runoff.

• Improve soil structure; through soil binding when it turn into humus, forming granules which facilitate air and water movement.

• Increases soil fertility; when organic matter decompose nitrogen, sulphur, phosphorus element because available to plant use.

• Improve water holding capacity; Soil water retaliation is influenced by good soil structure due to formation of humus.

• Regulate temperature; Due to its colour being brown-black, it can easily absorb heat of the sun.

• Supplies plant elements to the soil; Organic matter has high C.E.C(Cation Exchange Capacity) of which helps to withdraw such cation as K+, NH4, Mg++, Co++, for plant use Soil Air

In nutrient management, soil aeration influences the availability of many nutrients. Particularly, soil air is needed by many of the microorganisms that release plant nutrients to the soil. An

appropriate balance between soil air and soil water must be maintained since soil air is displaced by soil water.

Air can fill soil pores as water drains or is removed from a soil pore by evaporation or root absorption. The network of pores within the soil aerates, or ventilates, the soil. This aeration network becomes blocked when water enters soil pores. Not only are both soil air and soil water very dynamic parts of soil, but both are often inversely related:

An increase in soil water content often causes a reduction in soil aeration. Likewise, reducing soil water content may mean an increase in soil aeration.

Since plant roots require water and oxygen (from the air in pore spaces), maintaining the balance

between root and aeration and soil water availability is a critical aspect of managing crop plants.

Soil water

Physical Classification Gravitational water --- -1/3 bar Capillary water --- -1/3 to -31 bars Hygroscopic water -- -10,000 bars

Gravitational water: free water that moves through the soil due to the force of gravity. Gravitational water is found in the macro spores. It moves rapidly out of well drained soil and is not considered to be available to plants It can cause upland plants to wilt and die because gravitational water occupies air space, which is necessary to supply oxygen to the roots.

Drains out of the soil in 2-3 days

Capillary water: Water in the micro pores, the soil solution. Most, but not all, of this water is available for plant growth Capillary water is held in the soil. Against the pull of gravity

Forces Acting on Capillary Water

Micro spores exert more force on water than do macro pores

Capillary water is held by cohesion (attraction of water molecules to each other) and adhesion (attraction of water molecule to the soil particle). The amount of water held is a function of the pore size (cross-sectional diameter) and pore space

(total volume of all pores) this means that the tension (measured in bars) is increasing as the soil dries out.

Hygroscopic water: This water forms very thin films around soil particles and is not available to the plant. The water is held so tightly by the soil that it cannot be taken up by roots. not held in the pores, but on the particle surface. This means clay will contain much more of this type of water than sands because of surface area differences.

Hygroscopic water is held very tightly, by forces of adhesion. This water is not available to the plant.

Gravity is always acting to pull water down through the soil profile. However, the force of gravity is counteracted by forces of attraction between water molecules and soil particles and by the attraction of water molecules to each other.

• Soil Moisture Constants

These are the terms most commonly used when working with soil water. Terms us will use when making soil moisture calculations.

Saturation - all soil pores are filled with water. This condition occurs right after a rain. - This represents 0 bars.

Field capacity - moisture content of the soil after gravity has removed all the water it can. Usually occurs 1-3 days after a rain. - This would be -1/3 bar.

Wilting point - soil moisture percentage at which plants cannot obtain enough moisture to continue growing. - This is -15 bars.

Hygroscopic water - when the soil is about air dry - Water held at water potential less than than -31 bars. This water is not available to plants.

Oven dry - soil that has been dried in a oven at 105 degrees C for 12 hours. All soil moisture has been removed. This point is not important for plant growth but is important for calculations since soil moisture percentage is always based on oven dry weight.

Plant available water is that held in the soil at a water potential between -1/3 and -15 bars.

Soil formation factors and processes

Weathering of parent material

All rocks, when exposed for sufficient length of time to the atmosphere, undergo decay from disintegration and decomposition, together referred to as weathering.

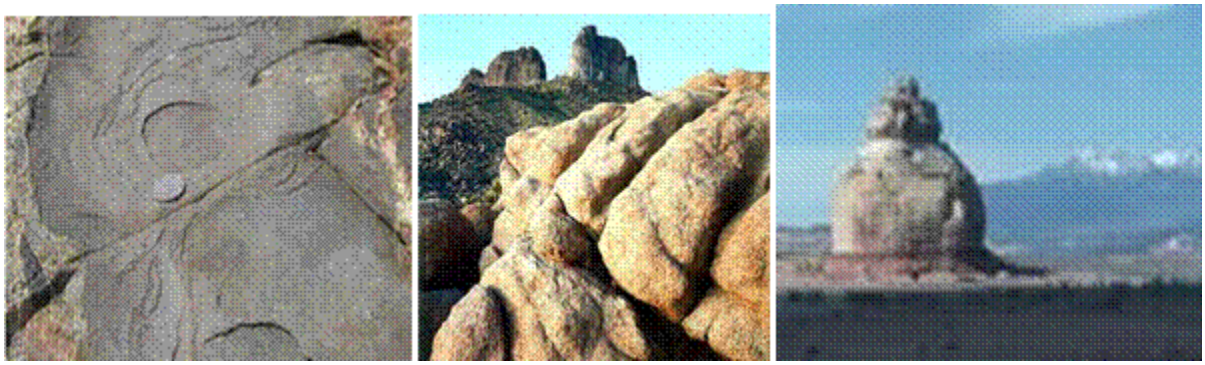
Disintegration is the break down into small particles by the action of mechanical agents of weathering such as rain, frost etc, and decomposition is the breakdown of mineral particles into new compounds by the action of chemical agents such as acid in air and in rain and river water.

Denudation is the general term used for the wearing down of land areas by the processes originating and acting at the earth's surface. It includes both weathering and erosion. In addition to the atmospheric processes, agents of erosion (rivers, moving ice, water waves) contribute to

the deduction of the land in their particular spheres of action, they also transport weathered and eroded material away from areas where it is derived, to from deposits of sediments elsewhere.

The weathering of parent material takes the form of physical weathering (disintegration), chemical weathering (decomposition) and chemical transformation. Generally, minerals that are formed under the high temperatures and pressures at great depths within the earth's mantle are less resistant to weathering, while minerals formed at low temperature and pressure environment of the surface are more resistant to weathering. Weathering is usually confined to the top few meters of geologic material, because physical, chemical, and biological stresses generally decrease with depth. Physical disintegration begins as rocks that have solidified deep in the earth are exposed to lower pressure near the surface and swell and become unstable. Chemical decomposition is a function of mineral solubility, the rate of which doubles with each 10 °C rise in temperature, but is strongly dependent on water to effect chemical changes. Rocks that will decompose in a few years in tropical climates will remain unaltered for millennia in deserts. Structural changes are the result of hydration, oxidation, and reduction.

Physical disintegration is the first stage in the transformation of parent material into soil. Temperature fluctuations cause expansion and contraction of the rock, splitting it along lines of weakness. Water may then enter the cracks and freeze and cause the physical splitting of material along a path toward the center of the rock, while temperature gradients within the rock can cause exfoliation of "shells". Cycles of wetting and drying cause soil particles to be abraded to a finer size, as does the physical rubbing of material as it is moved by wind, water, and gravity. Water can deposit within rocks minerals that expand upon drying, thereby stressing the rock. Finally, organisms reduce parent material in size through the action of plant roots or digging on the part of animals.



Chemical decomposition and structural changes result when minerals are made soluble by water or are changed in structure. The first three of the following list are solubility changes and the last three are structural changes.

• The solution of salts in water results from the action of bipolar water on ionic salt compounds producing a solution of ions and water.

• Hydrolysis is the transformation of minerals into polar molecules by the splitting of the intervening water. This results in soluble acid-base pairs. For example, the hydrolysis of orthoclase-feldspar transforms it to acid silicate clay and basic potassium hydroxide, both of which are more soluble.

• In carbonation, the reaction of carbon dioxide in solution with water forms carbonic acid.

Carbonic acid will transform calcite into more soluble calcium bicarbonate.

• Hydration is the inclusion of water in a mineral structure, causing it to swell and leaving it more stressed and easily decomposed.

• Oxidation of a mineral compound is the inclusion of oxygen in a mineral, causing it to increase its oxidation number and swell due to the relatively large size of oxygen, leaving it stressed and more easily attacked by water (hydrolysis) or carbonic acid (carbonation).

• Reduction the opposite of oxidation, means the removal of oxygen, hence oxidation number of some part of the mineral is reduced, which occurs when oxygen is scarce. The reduction of minerals leaves them electrically unstable, more soluble and internally stressed and easily decomposed.

AGENTS OF WEATHERING

1. Rain

The mechanical action of rain consists mainly in the washing of loose particles of soil and rock to lower levels. This phenomenon is known as rain-wash. It is the means by which rivers receive much of the sediments they carry in suspension. The chemical weathering effects of the rain are seen its solvent action on some rocks notably limestone. The process depends on the pressure of feeble acids, derived from gases such CO_2 and SO_2 which are present in air in small quantities and which enter into solution in rain water.

The denuding effects of heavy showers and rain-storms may be very severing, especially in regions where a covering of vegetation is lacking. It cuts gullies in the surface of the ground, some of considerable size and may cause great damage by the destruction of roads and livestock.

Heavy rains also promote landslides. Vegetation protects the ground from the immediate disintegrating effects of rainfall.

2. Frost

In cold climates the action of the frost is to break off angular fragment from exposed rock surface, a process sometimes referred to as ice-wedge. Water enters rock along pores, cracks and fissures. On freezing it expands and occupies about 10% greater volume exerting a pressure of about 2000 lbs per square inch. This is therefore like a miniature blasting and brings about the disintegration of the rock. The loosened particles fall from the mass and accumulate as heaps of talus at lower levels and this material may later be consolidate into a deposit known as breccia.

3. Wind

It is one of the two natural agents which transport rock material against gravity. Its effect is three-fold. First it removes loose particles of rock decay as it blows over a surface, then charged with these grains the wind act as an abrading sand-blast driving the grains against rock surfaces which becomes worn and polished in course of time. Thirdly the blown grains are accumulated to from sand-dunes.

Lines of communication may be seriously affected by wind-blown sand in arid countries. It is on record that the telegraphic wire on the trans-Caspian railway was worm down to half of its diameter in eleven years, and renewal was then made. To avoid accumulation of sand alongside railway embankments in Sudan, culverts have been made to allow for easy passage of the wind and its load sediments.

4. Insulation

When a rock surface is exposed to a considerable daily range of temperature, as in arid and semi-arid regions, the expansion which occurs during the day and contraction at night, constantly repeated have a weakening effect on the texture of the rock over a period of time . The outer heated layers tend to pull away from the cooler rock underneath a process known as exfoliation. By the unequal expansion and contraction of its mineral constituents the strain is set up in a rock and its texture is loosened. This kind of weathering is prevalent in climates where high day and low night temperatures are prevalent.

5. Weathering by organic materials

Plants retain moisture and any rock surface on which they grow is kept damp, thus aiding the solvent action of the water. The chemical decay of the rock is also promoted by the formation of vegetable humus organic product of the decay of plants. The mechanical break up of rocks is helped by the roots of plants which penetrates into cracks and crevices and tend to wedge apart the rock.

FACTORS AFFECTING SOIL FORMATION PROCESSES

Climate

The principal climatic variables influencing soil formation are effective precipitation (i.e., precipitation minus evapo-transpiration) and temperature, both of which affect the rates of chemical, physical, and biological processes. The temperature and moisture both influence the organic matter content of soil through their effects on the balance between plant growth and microbial decomposition. Climate is the dominant factor in soil formation, and soils show the distinctive characteristics of the climate zones in which they form. For every 10 °C rise in temperature, the rates of biochemical reactions more than double. Mineral precipitation and temperature are the primary climatic influences on soil formation. If warm temperatures and abundant water are present in the profile at the same time, the processes of weathering, leaching, and plant growth will be maximized. Humid climates favor the growth of trees. In contrast, grasses are the dominant native vegetation in sub humid and semiarid regions, while shrubs and brush of various kinds dominate in arid areas.

Water is essential for all the major chemical weathering reactions. To be effective in soil formation, water must penetrate the regolith. The seasonal rainfall distribution, evaporation losses, site topography, and soil permeability interact to determine how effectively precipitation can influence soil formation. The greater the depth of water penetration, the greater the depth of weathering of the soil and its development. Surplus water percolating through the soil profile transports soluble and suspended materials from the upper to the lower layers. It may also carry away soluble materials in the surface drainage waters. Thus, percolating water stimulates weathering reactions and helps differentiate soil horizons. Likewise, a deficiency of water is a major factor in determining the characteristics of soils of dry regions. Soluble salts are not leached from these soils, and in some cases they build up to levels that curtail plant growth. Soil profiles in arid and semi-arid regions are also apt to accumulate carbonates and certain types of expansive clays.

The direct influences of climate include:

- A shallow accumulation of lime in low rainfall areas as caliche
- Formation of acid soils in humid areas
- Erosion of soils on steep hillsides
- Deposition of eroded materials downstream
- Very intense chemical weathering, leaching, and erosion in warm and humid regions where soil does not freeze

Climate directly affects the rate of weathering and leaching. Wind moves sand and smaller particles, especially in arid regions where there is little plant cover. The type and amount of precipitation influence soil formation by affecting the movement of ions and particles through the soil, and aid in the development of different soil profiles. Soil profiles are more distinct in wet and cool climates, where organic materials may accumulate, than in wet and warm climates, where organic materials are rapidly consumed. The effectiveness of water in weathering parent rock material depends on seasonal and daily temperature fluctuations. Cycles of freezing and

thawing constitute an effective mechanism which breaks up rocks and other consolidated materials.

Climate also indirectly influences soil formation through the effects of vegetation cover and biological activity, which modify the rates of chemical reactions in the soil.

Topography

The topography, or relief, is characterized by the inclination (slope), elevation, and orientation of the terrain. Topography determines the rate of precipitation or runoff and rate of formation or erosion of the surface soil profile. The topographical setting may either hasten or retard the work of climatic forces.

Steep slopes encourage rapid soil loss by erosion and allow less rainfall to enter the soil before running off and hence, little mineral deposition in lower profiles. In semiarid regions, the lower effective rainfall on steeper slopes also results in less complete vegetative cover, so there is less plant contribution to soil formation. For all of these reasons, steep slopes prevent the formation of soil from getting very far ahead of soil destruction. Therefore, soils on steep terrain tend to have rather shallow, poorly developed profiles in comparison to soils on nearby, more level sites.

In swales and depressions where runoff water tends to concentrate, the regolith is usually more deeply weathered and soil profile development is more advanced. However, in the lowest landscape positions, water may saturate the regolith to such a degree that drainage and aeration are restricted. Here, the weathering of some minerals and the decomposition of organic matter are retarded, while the loss of iron and manganese is accelerated. In such low-lying topography, special profile features characteristic of wetland soils may develop. Depressions allow the accumulation of water, minerals and organic matter and in the extreme; the resulting soils will be saline marshes or peat bogs. Intermediate topography affords the best conditions for the formation of an agriculturally productive soil.

Organisms

Soil is the most abundant ecosystem on Earth, but the vast majority of organisms in soil are microbes, a great many of which have not been described. There may be a population limit of around one billion cells per gram of soil, but estimates of the number of species vary widely. Estimates range from 50,000 per gram to over a million species per gram of soil. The total number of organisms and species can vary widely according to soil type, location, and depth.

Plants, animals, fungi, bacteria and humans affect soil formation. Animals, soil mesofauna and micro-organisms mix soils as they form burrows and pores, allowing moisture and gases to move about. In the same way, plant roots open channels in soils. Plants with deep taproots can penetrate many meters through the different soil layers to bring up nutrients from deeper in the profile. Plants with fibrous roots that spread out near the soil surface have roots that are easily decomposed, adding organic matter. Micro-organisms, including fungi and bacteria, affect chemical exchanges between roots and soil and act as a reserve of nutrients.

Humans impact soil formation by removing vegetation cover with erosion as the result. Their tillage also mixes the different soil layers, restarting the soil formation process as less weathered material is mixed with the more developed upper layers.

Earthworms, ants and termites mix the soil as they burrow, significantly affecting soil formation. Earthworms ingest soil particles and organic residues, enhancing the availability of plant nutrients in the material that passes through their bodies. They aerate and stir the soil and increase the stability of soil aggregates, thereby assuring ready infiltration of water. As they build mounds, some organisms might transport soil materials from one horizon to another.

In general, the mixing activities of animals, sometimes called perturbation, tend to undo or counteract the tendency of other soil-forming processes that create distinct horizons. Termites and

ants may also retard soil profile development by denuding large areas of soil around their nests, leading to increased loss of soil by erosion. Large animals such as gophers, moles, and prairie dogs bore into the lower soil horizons, bringing materials to the surface. Their tunnels are often open to the surface, encouraging the movement of water and air into the subsurface layers. In localized areas, they enhance mixing of the lower and upper horizons by creating, and later refilling, underground tunnels. Old animal burrows in the lower horizons often become filled with soil material from the overlying A horizon, creating profile features known as crotovinas.

Vegetation impacts soils in numerous ways. It can prevent erosion caused by excessive rain that might result from surface runoff. Plants shade soils, keeping them cooler and slow evaporation of soil moisture, or conversely, by way of transpiration, plants can cause soils to lose moisture. Plants can form new chemicals that can break down minerals and improve the soil structure. The type and amount of vegetation depends on climate, topography, soil characteristics, and biological factors. Soil factors such as density, depth, chemistry, pH, temperature and moisture greatly affect the type of plants that can grow in a given location. Dead plants and fallen leaves and stems begin their decomposition on the surface. There, organisms feed on them and mix the organic material with the upper soil layers; these added organic compounds become part of the soil formation process.

Human activities widely influence soil formation. For example, it is believed that Native Americans regularly set fires to maintain several large areas of prairie grasslands in Indiana and Michigan. In more recent times, human destruction of natural vegetation and subsequent tillage of the soil for crop production has abruptly modified soil formation. Likewise, irrigating an arid region of soil drastically influences the soil-forming factors, as does adding fertilizer and lime to soils of low fertility.

Soil water

Further information: Water content and Water potential

Water affects soil formation, structure, stability and erosion but is of primary concern with respect to plant growth. Water is essential to plants for four reasons:

It constitutes 80%-95% of the plant's protoplasm. It is essential for photosynthesis.

It is the solvent in which nutrients are carried to, into and throughout the plant. It provides the turgidity by which the plant keeps itself in proper position.

In addition, water alters the soil profile by dissolving and re-depositing minerals, often at lower levels, and possibly leaving the soil sterile in the case of extreme rainfall and drainage. In a loam soil, solids constitute half the volume, gas one-quarter of the volume, and water one-quarter of the volume of which only half will be available to most plants.

A flooded field will drain the gravitational water under the influence of gravity until water's adhesive and cohesive forces resist further drainage at which point it is said to have reached field capacity. At that point, plants must apply suction to draw water from a soil. When soil becomes too dry, the available water is used up and the remaining moisture is unavailable water as the plant cannot produce sufficient suction to draw in the water. A plant must produce suction that increases from zero for a flooded field to 1/3 bar at field dry condition (one bar is a little less than one atmosphere pressure). At 15 bar suction, wilting percent, seeds will not germinate, plants begin to wilt and then die. Water moves in soil under the influence of gravity, osmosis and capillarity. When water enters the soil, it displaces air from some of the pores, since air content of a soil is inversely related to its water content.

The rate at which a soil can absorb water depends on the soil and its other conditions. As a plant grows, its roots remove water from the largest pores first. Soon the larger pores hold only air, and the remaining water is found only in the intermediate- and smallest-sized pores. The water in the smallest pores is so strongly held to particle surfaces that plant roots cannot pull it away. Consequently, not all soil water is available to plants. When saturated, the soil may lose nutrients as the water drains. Water moves in a drained field under the influence of pressure where the soil is locally saturated and by capillarity pull to dryer parts of the soil. Most plant water needs are supplied from the suction caused by evaporation from plant leaves and 10% is supplied by "suction" created by osmotic pressure differences between the plant interior and the soil water. Plant roots must seek out water. Insufficient water will damage the yield of a crop. Most of the available water is used in transpiration to pull nutrients into the plant.

Water retention forces; Water is retained in a soil when the adhesive force of attraction that water's hydrogen atoms have for the oxygen of soil particles is stronger than the cohesive forces that water's hydrogen feels for other water oxygen atoms. When a field is flooded, the soil pore space is completely filled by water. The field will drain under the force of gravity until it reaches what is called field capacity, at which point the smallest pores are filled with water and the largest with water and gases. The total amount of water held when field capacity is reached is a function of the specific surface area of the soil particles. As a result, high clay and high organic soils have higher field capacities. The total force required to pull or push water out of soil is termed suction and usually expressed in units of bars (105 Pascal, about one atmosphere) which is just a little less than one-atmosphere pressure. Alternatively, the terms "tension" or "moisture potential" may be used.