# CH: 3 Agriculture and the environment

### INTRODUCTION:

- The science that deals with cultivation (growing)of plants and keeping or breeding and raising of domesticated animals for food is called agriculture
- Derived from the Latin words ager soil and cultura cultivation or growing
- Agriculture includes cultivation of soil, and breeding and management of plants and animals

### Soil composition:

- Soil is the outer, loose layer that is found just below the surface of the Earth
- It is important because it is the medium in which most plants grow

# Soil is a mixture of four things:

- Inorganic **mineral** particles from **weathering** and **erosion** of **rocks** that are slowly broken down into smaller particles of different sizes
- Organic matter of living plants, animals and microorganisms and their decaying remains called **humus**
- Water from **precipitation** such as rain or snow that drains into it
- Air, which tends to be rich in **carbon dioxide** and poor in oxygen

### In general most soils contain

- 40 50 percent inorganic matter
- 5 percent organic material
- 25 percent water
- 25 percent air

- Silt soils have a particle size of between 0.002 and 0.05 mm, are fairly well drained compared with clay and tend to hold more moisture than sandy soil
- They can however become easily compacted when wet

# Loam soil:

- The soil is made of 40% sand, 40% silt and 20% clay
- It has a more equal mixture of small and large grains of rock
- This means it can retain water without getting waterlogged
- It also contains more humus than clay or sandy soil

Chalky soil is a light brown soil. Water drains through it quickly.

**Peat** is different from other soils because it does not contain any rock particles. It is made from very old decayed plants and is dark, crumbly and rich in nutrients (chemicals plants need to grow).

# Properties of a soil:

Soil texture - how it feels when you touch or rub

- Sandy feels gritty
- Silt feels silky
- Clay feels sticky

# Water holding and drainage: permeability, porosity

Water holding capacity of soil

How the water pass through the soil

### Air in the soil:

• spaces for the living organisms in soil to respire

### pH of soil:

• whether the Acidic or alkaline

#### Silt:

# Soil for plant growth:

- Plants require a number of **minerals** or nutritional elements from the soil for healthy growth and reproduction
- Minerals are absorbed mostly through their root hairs in the form of ions (electrically charged atoms or group of atoms), which are found in salts dissolved in soil water
- The most important minerals required by plants are nitrogen, phosphorus, potassium and magnesium

Mineral ion	Mineral element	How they are used in plantsand why needed
Nitrates NO3-	Nitrogen	For proteins, which are needed for cell growth. Nitrogen is needed t make amino acids for proteins
Phosphates PO4-	Phosphorus	Required for <b>respiration</b> and growth. Phosphorus is needed to make DNA and cell membrane.
Potassium K+	Potassium	Required for <b>photosynthesis</b> and respiration to function effectively
Magnesium Mg2+	Magnesium	Used for manufacturing <b>chlorophyll</b> for photosynthesis

- In addition to the mineral ions, **organic matter** in soil is the other natural source of plant nutrients
- Organic matter is the remains of a plant or animal that was once alive and which has returned to the soil and been decomposed into humus by **bacterial microorganisms**
- These and other decomposers such as worms and fungi function as an integral part of the nutrient or **carbon cycle**

# The organic content of soil is very important:

- It function as a reservoir of nutrients, which is constantly being released into soil and absorbed by plants
- Every 1 percent of organic matter in the soil will release between 9-14 kg of phosphorus pentaoxide and 1 2 kg of sulfur a year
- It greatly improves the water- holding capacity of soil
- It can store up to 90 percent of its weight in water, which releases slowly and evenly over a course of a year
- This even release helps to prevent plants becoming **waterlogged** in very wet periods and also to survive dry spells(dry period)
- It helps to bind or clump soil into aggregates that improve soil structure, allowing it to take up and hold water better
- Permeability, which is the ease with which water is able to infiltrate or move through the soil, will also improve with better soil structure
- It plays an important role in preventing soil erosion
- Increasing organic matter in soil by only 1 percent can reduce erosion by between 20 and 33 percent
- Organic matter helps to stabilise soil and promotes stronger plant root growth, which also has a binding effect
- It enables increased water infiltration, which prevents the soil drying out and becoming vulnerable to wind erosion
- Soil pH is a measure on a scale of 1 to 14
- Soils with a pH value of below 7 are considered acidic
- Values above 7 are alkaline (the opposite of acidic) and the readings of around 7 are considered neutral
- If the soil solution is too acid or alkaline, some nutrients will not dissolve easily and therefore will not be available for uptake by plant roots
- This can lead to plants suffering from nutrient deficiency

- A soil solution pH of between 6 and 7.5 is considered **optimal** for plants because most nutrients in the soil will dissolve easily in water at these levels
- When soil is acidic the nutrients of **Phosphorous, molybdenum, calcium** and **magnesium** will not dissolve easily
- As a result, concentrations of metal ions such as aluminium, magnesium and iron may become disproportionately high and even reach toxic levels
- Under alkaline conditions, plant growth can be restricted by a lack of iron, manganese, phosphorus, zinc, copper and boron in the soil water
- In addition, high levels of calcium in alkaline soil water may also decrease the **solubility** and **uptake** of potassium and manganese by plants

# Soil acidity:

- Even without rain, soil acidity naturally increases over time due to the **decomposition of organic matter** that naturally adds acid to the soil
- Environments rich in humus, such as forests with thick layers of decaying organic matter, will naturally tend to have more acidic soils
- than places such as hot deserts with little rainfall, sparse vegetation cover and decaying matter
- The **burning of coal** and other fossil fuels releases sulfur and nitrogen oxides as waste gases into the atmosphere, where they combine with water to form acids
- When this water condenses and falls as rain, acidic hydrogen is added to soils
- Soil acidity can also be increased through the use of **chemical-based fertilisers**on farms
- Adding limestone or calcium carbonate with magnesium (called liming) is the most common method used by farmers to raise the pH levels of acid soil to the more neutral levels in which most plants will grow

• Adding large quantities of organic matter such as natural manure compost and sulfur to alkaline soils has a similar effect of lowering pH levels to more neutral readings

# Differences between a sandy and clay soil:

Property	Sandy soil	Clay soil
Particle size	Large and fine (0.05 – 2 mm and is called a 'light' soil)	smallest particle size – (under 0.002mm across)pore spaces are minute and tends to be smooth Clay is known as a 'heavy' soil
Air content	High (many large air spaces between soil particles	Low (few and small air spaces)
	This an advantages to plants because their roots are able to use the large pore spaces to move easily through the soil This is benefit during heavy rain periods because the soil will only rarely become waterlogged In times of little rainfall, however, the same soil will dry out very quickly Their light texture and loose open structure – easy to plough and can be worked early in the growing season – because they warm up quickly	It is often very compact and difficult for plant roots to spread through
Drainage	Tend to drain quickly but have plenty of air	Tend to be water logged with little air content

	Because water drains quickly through sandy soils they tend to become acidic and infertile as many nutrients such as calcium are leached out	In times of heavy rain clay soils can become water logged and heavily compacted
Permeability to water(allowing water to pass through it)	High	Low
	To make sandy soils easier to cultivate and support crops, organic matter(compost), manure, leaf mould or clay is often added	Together these qualities create a thicker and heavier soil, more difficult to cultivate than sandy soils
	This not only increases the nutrient- holding capacity and pH levels, but also improves its <b>structure</b> and <b>water</b> <b>holding capacity</b>	This means that there are few gaps between for water to drain through Therefore clay soil can
		become waterlogged in heavy rain
		It contains little air, especially when wet, because there is not much space between its small particles

# Clay soil:

- Advantage although they tend to be alkaline, they are potentially very fertile because high concentrations of nutrients get trapped between their fine particles
- Adding bulky organic matter, which helps to combine the fine clay particles into large separate clods, is often required to release the nutrients for uptake by plant roots

Agriculture is the term used to describe the act of growing crops and raising livestock for human consumptionand use

(Or)

• Agriculture or farming is the cultivation of the soil for the growing of crops and the rearing of animals

Two main types:

- Subsistence farming
- Commercial farming

# Subsistence farming:

- It is self- sufficiency farming in which farmers concentrate on growing or rearing enough food to **feed themselves** and their **families**.
- It is to ensure the survival of individual family
- If there is excess food produced, it is sold locally to other families or individuals
- This type of agriculture is very labour- intensive because all of the work is done by humans and animals and only hand tools and simple machines are used to work the land
- Low levels of technology and household labour are used to produce on small output

# Advantages of subsistence farming:

- It full fills the basic needs of a family, such as food and clothing
- A small area like a backyard garden is enough for cultivation
- It requires low capital requirement
- There is no labour cost involved. The main source of labour are the family members of the family

# Disadvantage of subsistence farming:

- The family labour is unreliable because they are not paid for working on the farm
- The produce is consumed by the family. It does not involve any profit by selling the produce
- Crops may get destroyed as no pest or disease control measures are adopted
- It aimed at producing food for the family of the farmer. Hence it does not fulfil the nation's increased demand for food

#### Two types:

- Intensive subsistence farming
- Primitive subsistence farming

#### Intensive subsistence farming:

- The farmer cultivates a small plot of land using **simple tools** and **more labour**
- Uses high inputs of money, labour and fertilizer etc
- Climate with large number of days with **sunshine** and **fertile soils** permit growing of more than one crop annually on the same plot
- **Rice** is the main crop (other crops wheat maize, pulses and oilseeds
- It is widespread in the thickly populated areas of the monsoon regions of South, South East and East Asia

### Primitive subsistence farming:

Includes

- Shifting cultivation
- Nomadic herding

### Shifting cultivation:

- It is a sustainable method of agriculture and traditional method which has beenpractised in the areas of heavy rainfall(Amazon basin, tropical Africa, parts of southeast Asia and northeast Asia) and quick generation of vegetation
- A small area of land is cleared and the vegetation burned, providing a source of nutrients from the ash
- The ashes are then mixed with the soil which becomes fertile to grow crops
- After the soil loses its fertility, the land is abandoned and the cultivator moves on and clears another small area of a new plot or forest
- The original area is regenerated, as it receives nutrients and seeds from surrounding vegetation
- As no lasting damage occurs, this method of agriculture is sustainable
- It is sometimes called 'slash and burn' agriculture

# Disadvantage:

• It is highly a unsustainable form of agriculture and ecologically very damaging to forest ecosystems

### Nomadic herding:

- Nomadic herding is practiced in the semi- arid and arid region (having little or no rain) of Sahara, central Asia
- In this type of farming, herdsman move from place to place with their animals for fodder and water
- This type of movement arises in response to climatic constraints(limitation) and terrain
- Sheep, camel, yak and goats are the most commonly reared
- They provide milk, meat, wool, hides and other products to the herders and their families

### **Extensive farming:**

- It is where a relatively small amount of produce is generated from a large area of farmland
- Uses small inputs of labour, money and fertiliser

# Commercial farming:

- It is farming for a profit growing crops or rearing animals to sell at market
- Most of the work is done by modern machines and technologies such as Geographic information systems
- Almost all farming in **MEDCs** (more economically developed countries) around the world is commercial
- Commercial farms may be arable, pastoral or mixed
- Arable (the production food, fodder and industrial crops) cultivate crops and are not involved in livestock
- An arable farm may concentrate on one crop (monoculture) such as wheat or may grow a range of different crops
- Crops grown on arable farm may change overtime
- For example: if the market price of tomato increases, more farmer will be attracted to grow this crop
- Pastoral (rearing animals for meat and animal products such as wool
- Mixed (both arable and livestock)

Main differences between subsistence and commercial farming types farming:

Subsistence	Commercial
Mainly for own consumption	farming <b>for sale</b> of products
orProducing enough for ones need	
Small- scale/ small farms	Large- scale/ large farms
More reliable on human and animal	mechanised
power	
Wider variety of crops / mixed farming	More specialised/ perhaps one
with animals	plantations/ monoculture
Low inputs/ investments	High inputs/ large investments

### Importance of planting trees to conserve soil:

- Trees generally increase rainfall interception
- Rainfall reaches the ground more slowly
- As trunk flow and canopy drip slow the movement of water
- Trees stop heavy rain hitting or eroding the surface of the soil and it reduce runoff
- Organic matter from trees improves soil structure
- Trees acts as windbreaks providing shelter from prevailing winds
- Their roots help to hold the soil together

# Strategies for conserving soil:

**Soil conservation** is the preventing of soil loss from erosion or reduced fertility caused by over usage, acidification, and otherchemical soil contamination

# Techniques for improved soil conservation include:

Terrace ploughing, contour ploughing, dry land farming, crop rotation, mixed farming, mulch, integral rural development programmes, community participation, land reform