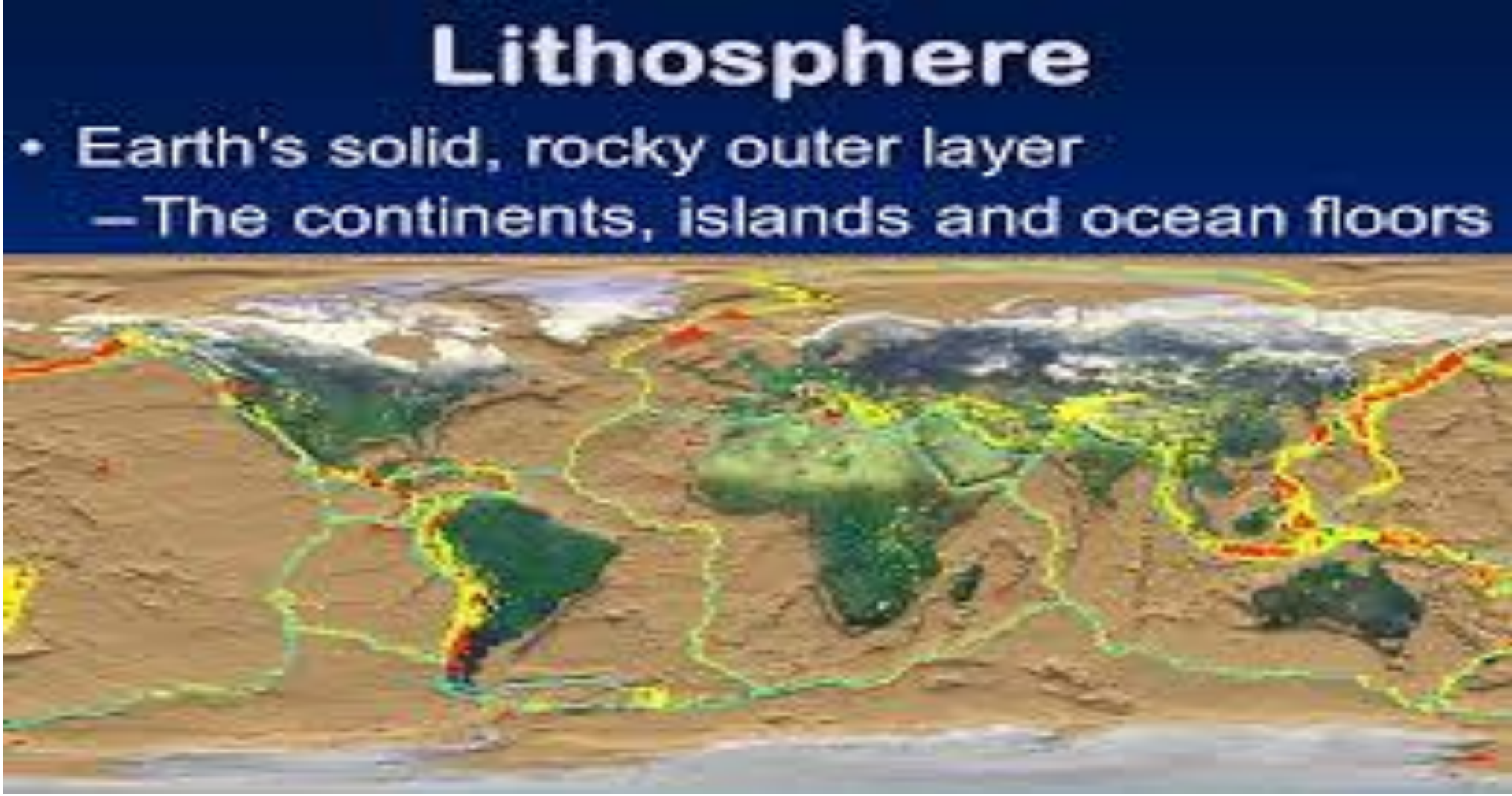


LITHOSPHERE

Dr. Shakha Sharda

INTRODUCTION

- lithosphere is the rigid rocky outermost shell of the earth.
- formed by hot molten material
- rich in organic matter
- science deals with study of earth is seismology


Oceanic Crust
Continental Crust
Lithosphere
Lithosphere
Upper Mantle
Lithosphere (Upper Mantle)

Types of weathering

- Physical : heating and cooling, water, wind
- Chemical : hydrolysis, oxidation, carbonation
- Biological : plants; phytosphere
  animals; zoosphere
- Process of soil development: Paedogenesis
- Study of formation of soil : Paedology


Chemical
Weathering


Physical
Weathering


Biological Weathering

Factors affecting soil formation

- Active factors
  - temperature
  - humidity/moisture
  - organisms
- Passive factors
  - parent material
  - topography
  - time

Soil profile

- **O-horizon (organic)- Litter Layer**

  topmost horizon containing organic matter

  organic matter starts

- **A-horizon**

  humus and other organic materials are mixed with mineral particles

  dark in colour and porous

- **B-horizon**

  mineral soil layer consisting of clay, silt and sand

  coarse textured, large amounts of iron and aluminium compounds

  A and B together are called : SOLUM

  solum along with O- horizon : TOP SOIL

- **C-horizon**

  incomplete weathered rocks, poorly developed

- **D-horizon**

  unweathered parent rock forms base of soil profile

O - The overlying organic horizon

A - Humus horizon

B - Mineral horizon

Top Soil

Solum

C - Pedogenic substrate

D - Parent rock

SOIL STRUCTURE SHOWING DIFFERENT LAYERS

Soil Classification

- On the basis of *mode of formation*

❖residual soil: found at the place of their formation

❖transported soil: taken away at other places

I. colluvial soil: gravity
II. alluvial soil: running water
III. glacial soil: moving of glaciers
IV. eolian soil: wind

On the basis of *nature and composition*

- **Black soil**
  - ideal for cotton crop
  - formed due to solidification of lave
  - black due to compounds of iron and aluminium
  - mainly found in Deccan Plateau
  - high moisture retention level
  - lack in P, N and organic matter

Black Soil in Madhya Pradesh

- **Red soil**
  - formed due to decomposition of ancient crystalline rocks like granites
  - rich in iron and magnesium
  - cover Tamil Nadu, Karnataka, Andhra Pradesh, S.E. Maharashtra
  - deficient in N, P and humus but rich in potash
  - suitable for rice, millets, tobacco and vegetables

- **Laterite soil**
  - consists of clay rich in iron and aluminium hydroxide
  - soil is found in typical monsoon conditions
  - found in Western Ghats, Eastern Ghats, Maharashtra, Karnataka, Kerala, Orissa, West Bengal, Assam
  - poor in N and minerals
  - best for tea, coffee, rubber, cinchona, coconut, rice and millet

LATERITE SOILS

- **Forest and mountain soil**
  - found on hill slopes
  - formed by deposition of organic matter
  - very rich in humus
  - deficient in potash, P and lime
  - plantation of tea, coffee, spices and tropical fruits

Arid and desert soils

  - sandy and poor in organic matter
  - found in arid regions in Rajasthan
  - nitrates and phosphates are present

Desert Soil

- **Saline and alkaline soils**
  - found in drier parts of Bihar, U.P., Haryana, Punjab, Rajasthan and Maharashtra
  - accumulation of salts make the soil infertile
- **Peaty soils**
  - large amount of organic matter
  - found in districts of Kerala
- **Marshy soils**
  - high in vegetable matter
  - found in northern Bihar, coastal parts of Orissa, Tamil Nadu, West Bengal and parts of U.P

Peaty & Marshy soil

Components of soil

- **<u>Mineral matter/ inorganic matter (approx.45%)</u>**

I. gravel more than 2mm in diameter

II. coarse sand: 0.2-2 mm in diameter

III. fine sand : 0.02-0.2 mm in diameter

IV. silt : 0.002-0.02 mm in diameter

V. clay : less than 0.002 mm in diameter

Water holding capacity: Clay> Silt> Sand>Gravel

- **Soil Air (approx.25%)**
- **Soil water (approx.25%)**

  capillary water: only available water

  combined water: hydrated oxides

  hygroscopic water: inside soil particles

  gravitational water: flows down the earth

  run-off water: flows down the slope
- **Organic matter (approx.5%)**

  litter: undecomposed

  duff: partially decomposed

  humus : fully decomposed

- Soil nutrients
    - macro-nutrients (9)
    - micro-nutrients (7)

  eutrophic soil : nutrient rich soil

  oligotrophic soil : nutrient deficient soil

Soil organisms

  macro-organisms: rodents; rats and rabbits

  meso-organisms: annelids; earthworms, snakes

  micro-organisms: micro-organisms; bacteria

फसलों में पोषक तत्वों की कमी के लक्षण

लाभदायक फसल उत्पादन के लिए पोषक तत्वों की कमी के चिह्नों को पहचान कर उन्हें दूर करना प्रत्येक कृषक का कर्तव्य होना चाहिए। वैज्ञानिकों द्वारा कमी के लक्षणों को जो फसल की पत्तियों/तना एवं पुष्पण में दिखाई देते हैं, की पहचान के तरीके बताये गये हैं। उनके आधार पर फसलों को देखकर उनकी कमी के लक्षणों को देखकर जानकारी की जा सकती है।

पोषक तत्वों की कमी प्रायः पौधों की पत्तियों में रंग परिवर्तन से ज्ञात होता है। आवश्यक पोषक तत्वों के कमी के लक्षण निम्नवत हैं।

बोरान
वर्धनशील भाग के पास की पत्तियों का रंग पीला हो जाता है। कलियां सफेद या हल्के भूरे मृत ऊतक की तरह दिखाई देती है।

गंधक
पत्तियां, शिराओं सहित, गहरे हरे से पीले रंग में बदल जाती है तथा बाद में सफेद हो जाती है। सबसे पहले नई पत्तियां प्रभावित होती हैं।

मैंगनीज
पत्तियों का रंग पीला-धूसर या लाल-धूसर हो जाता है तथा शिराएं हरी होती हैं। पत्तियों का किनारा और शिराओं का मध्य भाग हरितिमाहीन हो जाता है। हरितिमाहीन पत्तियां अपने सामान्य आकार में रहती हैं।

जस्ता
सामान्य तौर पर पत्तियों के शिराओं के मध्य हरितिमाहीन के लक्षण दिखाई देते हैं और पत्तियों का रंग कांसा की तरह हो जाता है।

मैग्नीशियम
पत्तियों के अग्रभाग का रंग गहरा हरा होकर शिराओं का मध्य भाग सुनहरा पीला हो जाता है अन्त में किनारे से अन्दर की ओर लाल-बैंगनी रंग के धब्बे बन जाते हैं।

फास्फोरस
पौधों की पत्तियाँ फास्फोरस की कमी के कारण छोटी रह जाती हैं तथा पौधों का रंग गुलाबी होकर गहरा हरा हो जाता है।

कैल्शियम
प्रारंभिक पत्तियां पहले प्रभावित होती है तथा देर से निकलती हैं। शीर्ष कलियां खराब हो जाती हैं। मक्के की नोकें चिपक जाती हैं।

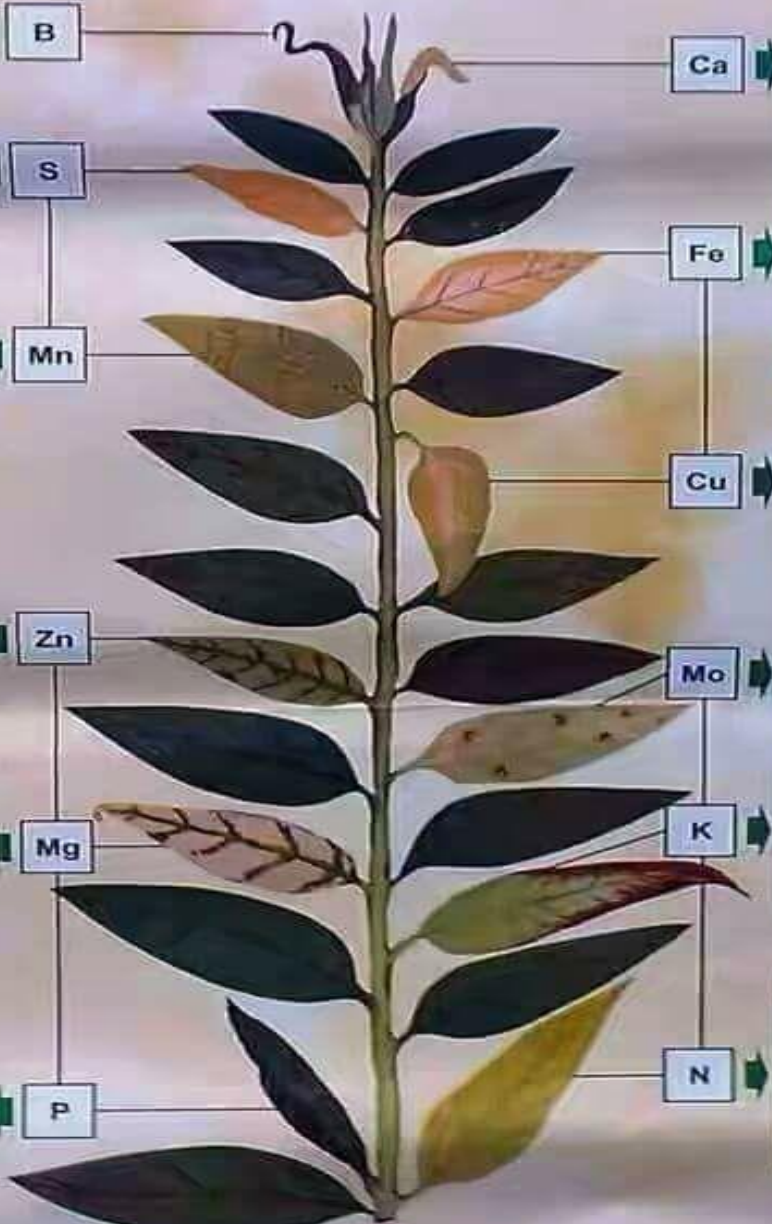
लोहा
नई पत्तियों में तने के ऊपरी भाग पर सबसे पहले हरितिमाहीन के लक्षण दिखाई देते हैं। शिराओं को छोड़कर पत्तियों का रंग एक साथ पीला हो जाता है। उक्त कमी होने पर भूरे रंग का धब्बा या मृत ऊतक के लक्षण प्रकट होते हैं।

ताबा
नई पत्तियां एक साथ गहरी पीले रंग की हो जाती है तथा सूख कर गिरने लगती हैं। खाद्यान्न वाली फसलों में गुच्छे में वृद्धि होती है तथा शीर्ष में दाने नहीं होते हैं।

मालिब्डेनम
नई पत्तियां सूख जाती है, हल्के हरे रंग की हो जाती है मध्य शिराओं को छोड़कर पूरी पत्तियों पर सूखे धब्बे दिखाई देते है। नाइट्रोजन के उचित ढंग से उपयोग न होने के कारण पुरानी पत्तियां हरितिमाहीन होने लगती है।

पोटेशियम
पुरानी पत्तियों का रंग पीला/भूरा हो जाता है और बाहरी किनारे कट-फट जाते है। मोटे अनाज यथा मक्का एवं ज्वार में ये लक्षण पत्तियों के अग्रभाग से प्रारम्भ होते हैं।

नाइट्रोजन
पौधे हल्के हरे रंग के या हल्के पीले रंग के होकर बौने रह जाते हैं। पुरानी पत्तियाँ पहले पीली (हरितिमाहीन) हो जाती है। मोटे अनाज वाली फसलों में पत्तियों का पीलापन अग्रभाग से शुरू होकर मध्य शिराओं तक फैल जाता है।



Soil texture

- Sandy soil
  - light soil; 85% sand; 15% silt and clay
  - high porosity
  - loose soil with low water holding capacity
  - less fertile, not rich in nutrients
- Clay soil
  - 50%clay and 50% silt or sand
  - cold or heavy soil
  - very fine grained material with very less air spaces
  - fine pore spaces have high water holding capacity

- Silt soil
  - minerals like quartz and fine organic particles
  - 90% silt; 10% sand (most fertile)
  - good porosity
  - poor in nutrient supply
- Loamy soil
  - 40% sand, 40% silt and 20% clay
  - best soil for plant growth
  - root penetration is good
- Sandy loamy soil
  - 70% sand, 30% clay and 30% silt
  - moderate coarse textured
  - good water holding and good aeration

Contents

- **Soil Translocation**
- **Soil Pollution and its types**
- **Soil pollutants**
- **Soil erosion and its types**
- **Causes of soil erosion**
- **Prevention and control of soil pollution**
- **Methods of soil conservation: Forestry**
  Agricultural
  Mechanical

Soil Translocation

- Leaching

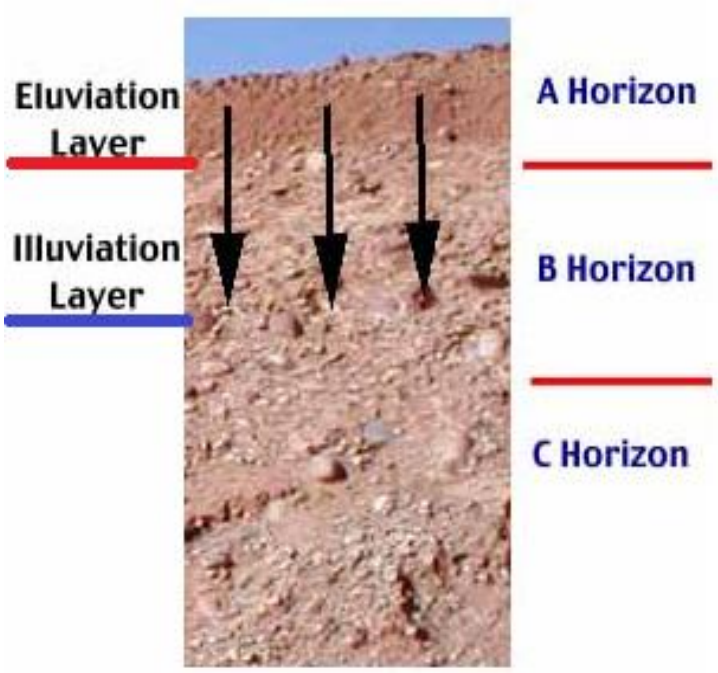
complete chemical removal of substances from the soil profile

- Eluviation

movement of fine mineral particles out of an upper layer in a soil profile

- Illuviation

deposition of fine mineral particles in a lower soil layer



Soil Pollution

- Alteration in physical, chemical and biological properties of soil by addition or removal of substances and factors which decreases the soil fertility is called soil pollution.
- Soil pollution can be positive and negative.

Soil pollution and its pollutants

- **Positive soil pollution** is due to addition of unwanted wastes in the soil like: urban waste, industrial waste, agricultural activities, mining, hospital waste, radioactive wastes etc.
- **Negative soil pollution** is due to loss of various components from the soil through soil erosion by water and air, faulty cropping pattern, intensive agriculture, imbalance use of fertilizers and development activities like urbanization, industrialization, mining, construction etc.

Soil pollution and pollutants

Soil Erosion

Soil erosion is slow and continuous process of loss of top layer of soil by natural as well as man-made processes, also known as creeping death of soil.

It can be normal/geological erosion and accelerated erosion

Agents of soil erosion

Water and wind are the main agents of soil erosion.

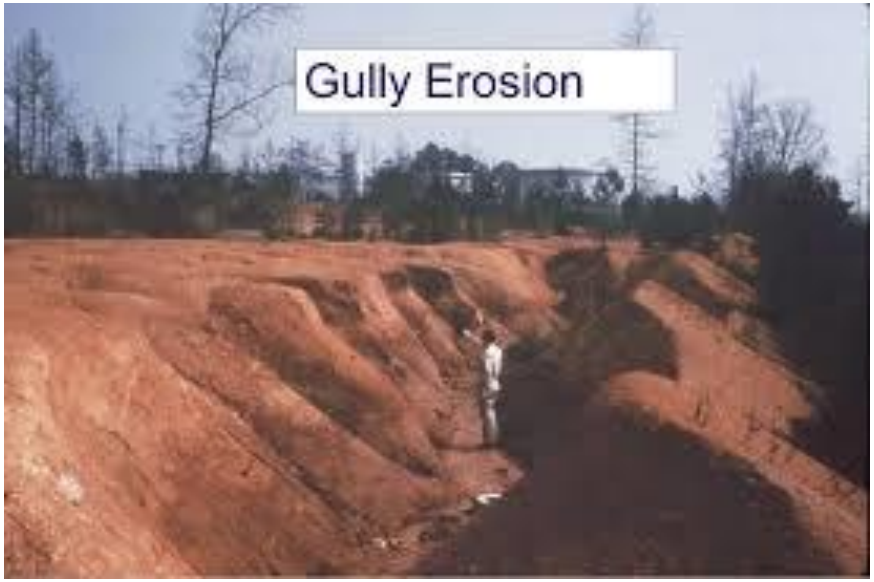
- **Water erosion** is the loosening of soil particles by surface flow action of water and falling of rain drops is called water erosion. The types of water erosion are:

- Sheet erosion: when the top layer of soil is washed away in uniform layering over larger area is called sheet erosion. This type of erosion is most destructive and unseen erosion, mostly seen in plains.
- Rill erosion: The well-defined finger-like small channels are formed, when silt laden water moves down from hill/mountain from where it carried away soil particles is called rill erosion.
- Gully erosion: When the rills formed are not checked, these thin channels become wider, form deep / larger grooves called gullies. It further takes away large portion of top soil due to heavy rains/water.in simple words, extended form of rill erosion is gully erosion, mostly seen in hills/mountains.

Sheet Erosion picture

Soil accumulated along fencelines could be an indicator

Sheet erosion in action displaying fine sediment runoff leaving coarser material



- **Wind erosion**: This type of erosion is common in dry/arid regions, where the soil is mainly sandy with poor vegetation. This erosion is due to deforestation and overgrazing, causing more dust storms resulting in saltations (evaporation of water due to high temperature leaving salt behind), suspension (fine dust suspended in air deposited on other place by wind), surface creep(heavier soil particles simply pushed along the wind).
- Other form of erosion is landslides (rocks fall of due to heavy rains/winds under the influence of gravity) and river/stream bank erosion due to high speed of water mainly from the curves of stream, also known as riparian erosion.

Causes of soil erosion

- Deforestation
- Overgrazing
- Shifting cultivation
- Faulty agricultural practices
- Litter collection

Causes of soil erosion

- **Deforestation**: Cutting down of trees in large numbers results in flash floods due to little obstruction in the movement of water. Water retaining capacity of soil also decreases leads to soil erosion.
- **Overgrazing**: Overgrazing of mountains, forests and pastures by cattle, sheep and goats make the soil loose, which becomes prone to both water and soil erosion.
- **Shifting Cultivation**: This practice is common in North-east India where land is clear for cultivation, and tribal people move to another patch of forest for cultivation. This practice of clearing the forest at different places for crop cultivation is called shifting/jhum cultivation, prevalent in Jhum forests.
- **Faulty agricultural practices**: Faulty cropping pattern also cause soil erosion by wind and water. For example, wheat-rice cropping pattern in Punjab is one of the major reasons for degradation of soil quality.

Prevention and control of soil pollution

- Reduction of wastes at the source generation.
- Recycling of garbage wastes example, paper, rags, plastics, metals, glass, polyethylene etc.
- Judicious /minimize the use of chemical fertilizers and pesticides.
- Agricultural/ Horticultural/ garden wastes like husk, leaves, twigs, bagasse can be recycled to form board/paper/compost.
- Increase the use of bio fertilizers, manure and compost.
- Encourage the practice of planting saplings by afforestation and reforestation.

Methods of soil conservation

Forestry Methods

- Reforestation- Planning trees in denuded areas.
- Afforestation- Planning trees on bare regions.
- Pastures- Controlled grazing through pastures development can decrease soil erosion.
- Wind breaks- Planning alternate rows of trees and shrubs at right angles to divert wind direction, reduce wind speed and prevent erosion.

Methods of soil conservation

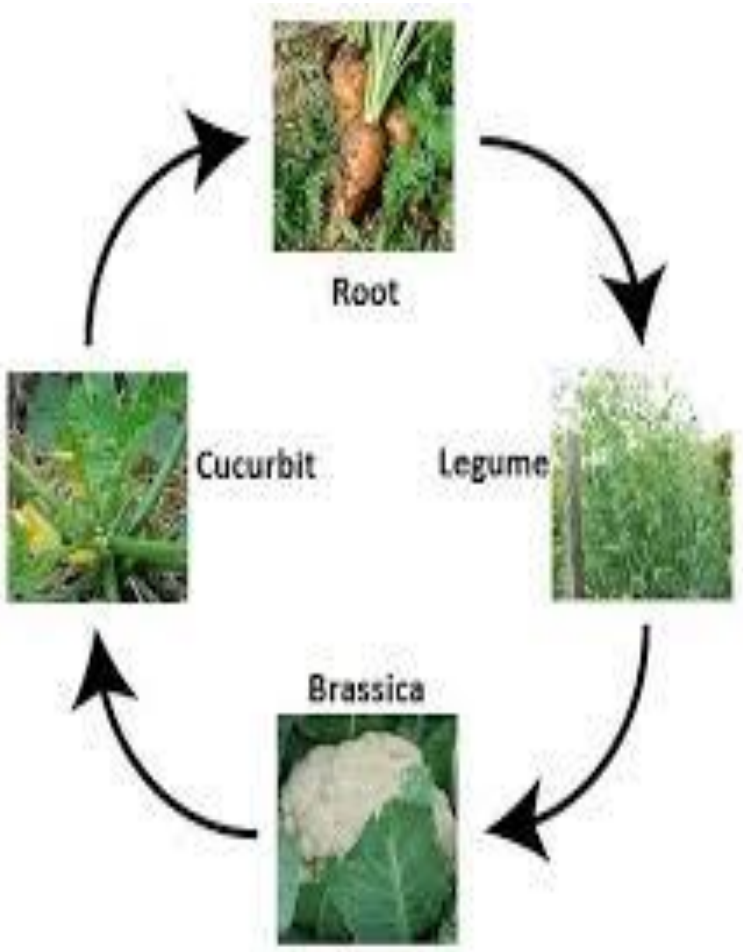
Agricultural Methods

- **Crop Rotation**- Rotation of leguminous crops with non-leguminous crops in successive seasons on same piece of land maintains soil fertility and decrease soil loss.
- **Mulching**- To cover the harvested field with plant waste or cover plants or polyethylene in order to prevent run off of top soil and water retention.
- **Contour farming/ploughing**- Ridges and furrows are formed alternately at right angle to the slope to prevent soil erosion through wind and water.
- **Mixed/Multiple farming**- it is the practice of growing two/more crops simultaneously on the same piece of land.
- **Fallowing**- Land remain uncultivated for one/two years. This helps in restoration of quality of soil as it increases mineral and organic content of the soil.
- **Green Manuring**- Addition of manure(agricultural wastes through anaerobic decomposition) and compost(vermicomposting by earthworms through aerobic decomposition).

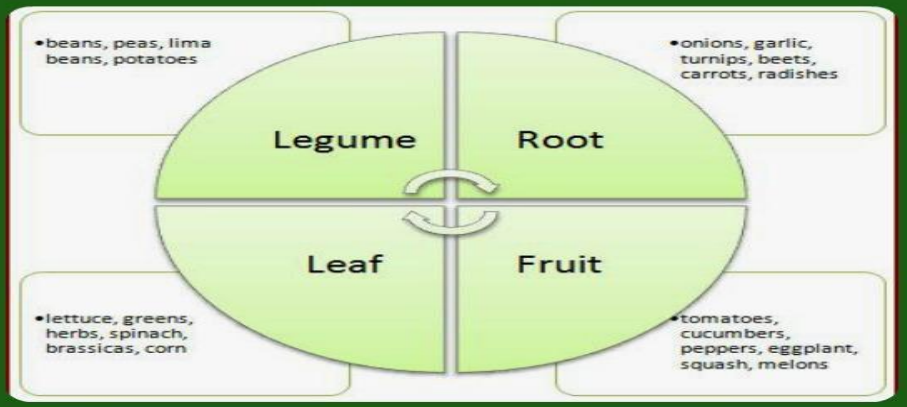
Methods of soil conservation

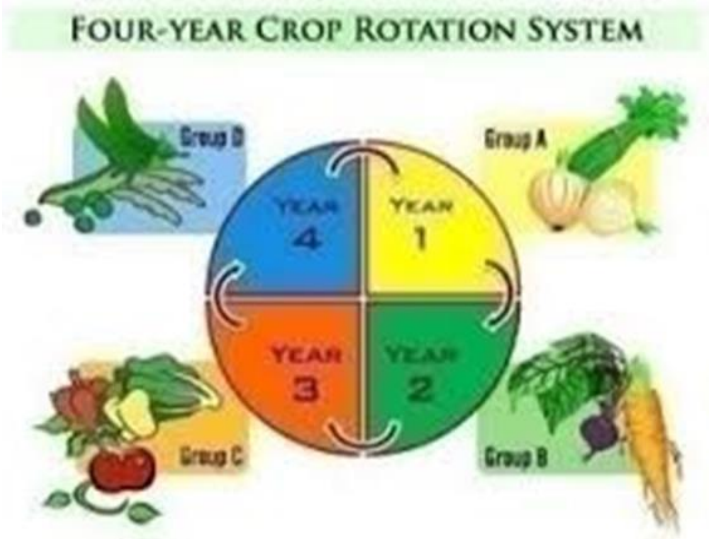
Mechanical Methods

- **Terracing**- Division of hill slopes into different terrace to prevent soil erosion and planting crops at alternate angles.
- **Contour Bunding-** Small bunds are formed on the edges of fields to prevent soil loss.
- **Contour trenching**- Formation of series of small ditches to check water and wind erosion.
- **Gully control**- Construction of check/earthen dams, bunds, drains and diversions to check excessive run off of top soil.



Garden Crop Rotation
– A Simple System




FOUR-YEAR CROP ROTATION SYSTEM
Group D
Group A
YEAR 4
YEAR 1
YEAR 3
YEAR 2
Group C
Group B


Pastures


Contour Farming


Terrace Farming


Stronger winds held aloft
Calm even wind
Wind Breaks


Contour Bunding