

SOIL

SOIL

- The collection of natural bodies occupying parts of the earth's surface that have properties due to integrated effect of physical, chemical and organic processes so that it can support plant growth.



Weathering of Rocks and Minerals

- Weathering refers to the physical, chemical and biological factors/processes that disintegrate and decompose rocks and the minerals contained in them, at or near the earth's surface, into separate solid particles and dissolved materials.

Controlling factors of weathering:

Structure and composition of rocks

- Nature of ground slope
- Climatic variations
- Floral effects

Types of Weathering process

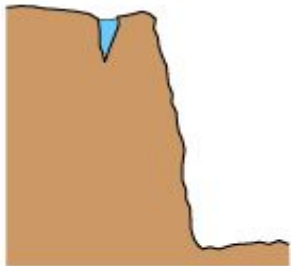
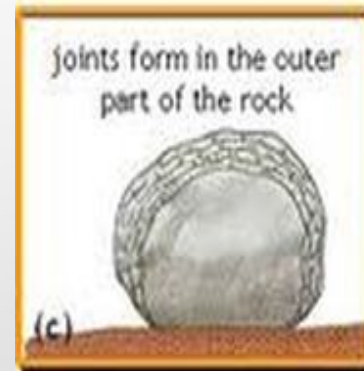
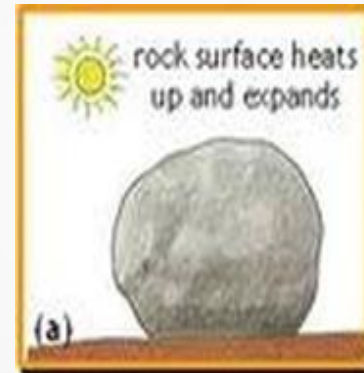
- **Physical weathering** breaks rocks into small mineral particles.

- Agents:

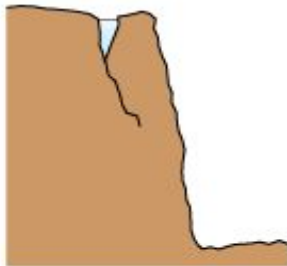
- Water
- Frost
- Temperature
- Wind

Types of Physical weathering

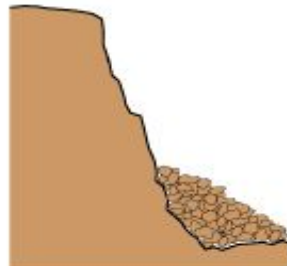
- Block disintegration due to temperature change
- Granular disintegration due to temperature change
- Shattering due to rain shower and heat
- Block disintegration due to frost
- Exfoliation due to wind and temperature



Rainwater collects in a crack.



The temperature falls below 0°C. The water freezes and expands, making the crack bigger



Eventually after repeated freezing and thawing, the rock breaks off.

PHYSICAL WEATHERING

- **Chemical weathering:** Disintegration and decomposition of rocks due to chemical reactions is called chemical weathering wherein the minerals of the rocks weather away.
- **Biological weathering :** Biological weathering occurs by biological agents like microorganisms, plant roots etc which can cause the breakdown or bind the particles together .



WEATHERING

Erosion

The wearing away of land surface by wind, water, ice or other geologic agents. Soil erosion is the detachment and movement of soil particles by water, wind ice or gravity.

It is a natural process happening all the time, but usually slowly because of the protective coverage of vegetation. It is part of both soil formation and soil loss.

Why concerned about soil erosion? - top layer of soil or topsoil (12-25cm) contains essential chemical elements for plants and soil biota.

Erosion can occur naturally and also be accelerated by human activities.

- Rates of soil erosion are highest in dry climates where there is little surface vegetation to shelter the soil against wind.
- On steep slopes in wet climates where the gradient increases the speed of surface water flows during heavy rainfall.
- Humans cause soil erosion (clear natural vegetation)

Three major human practices that expose soil to erosion and lead to soil degradation are over cultivation, overgrazing and deforestation.

Factors of Soil Erosion

Climatic factors

- include the amount and intensity of precipitation, the average temperature, as well as the typical temperature range, and seasonality, the wind speed, storm frequency.

Geologic factors

- include the sediment or rock type, its porosity and permeability, the slope (gradient) of the land, and if the rocks are weathered or not.

Biological factors

- include ground cover whether it is covered by vegetation or not, the type of organisms inhabiting the area, and the land use.

In general, areas with high-intensity precipitation, more frequent rainfall, more wind, or more storms are expected to have more erosion.



Effects of Soil Erosion

- Land becomes less productive.
- Crop yields go down.
- Cost of farming go up.
- Environmental calamity like famine or flood becomes more frequent.
- Eroded particles increase the amount of sediment at rivers.

Soil Forming factors:

- Climate
- Organisms
- Parent Material
- Topography
- Time

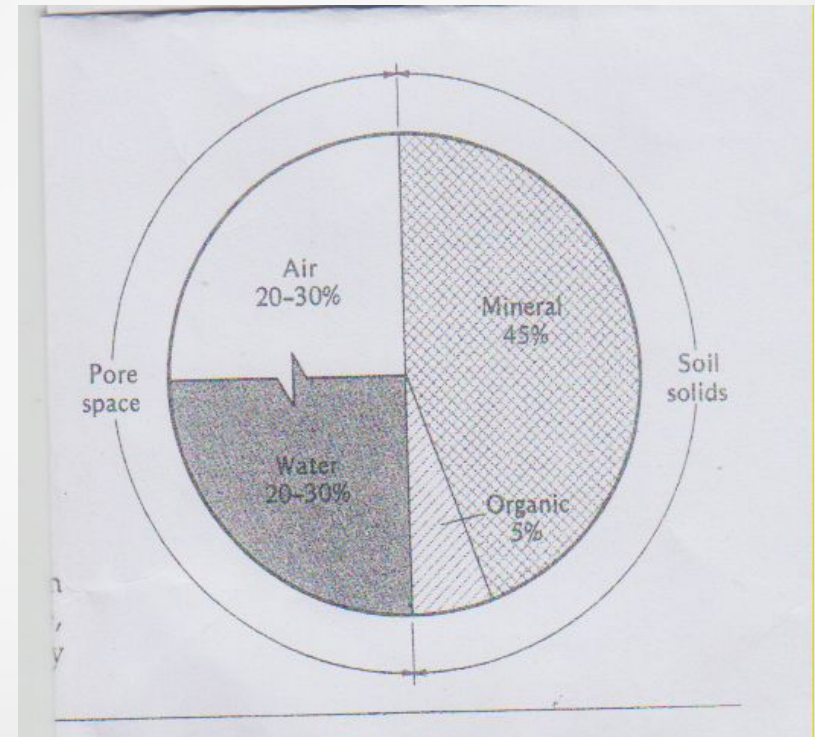
Interactions of Soil Forming Factors

The formation of soil is a complex process, and the five soil formation factors are active simultaneously and interdependently. Individual factors are of interest because they help us simplify and explain soil formation.

Composition of Soil

Consists of four major components-

- Organic matter : 5%
- Mineral matter : 45%
- Water : 20-30%
- Air : 20-30%



Soil is made up of air and water in roughly equal parts, although the percentages keep changing depending on the water. Mineral particles are formed by weathering of the rock. Organic matters from dead plant and animals.

Soil Texture

The mineral particles present in soil vary in size. The size ranges between 2 mm to less than 0.002 mm in diameter. Depending on size there are three types of soil particles:

- Sand
- Silt
- Clay

The relative proportions of sand, silt and clay in soil is called soil texture. Soil texture is important because

- Influence on soil properties
- Effects the suitability of soil for most uses



Soil Horizon and Profile

- The process of soil formation creates vertical difference in layers that are often quite distinct. These horizontal layers are known as horizons.
- A vertical slice through the different horizons is called the soil profile.
- Why study soil profile- can learn about the type and characteristics of soil and helps determine how the soil can be used.



O horizon
(loose and partly
decayed organic
matter)

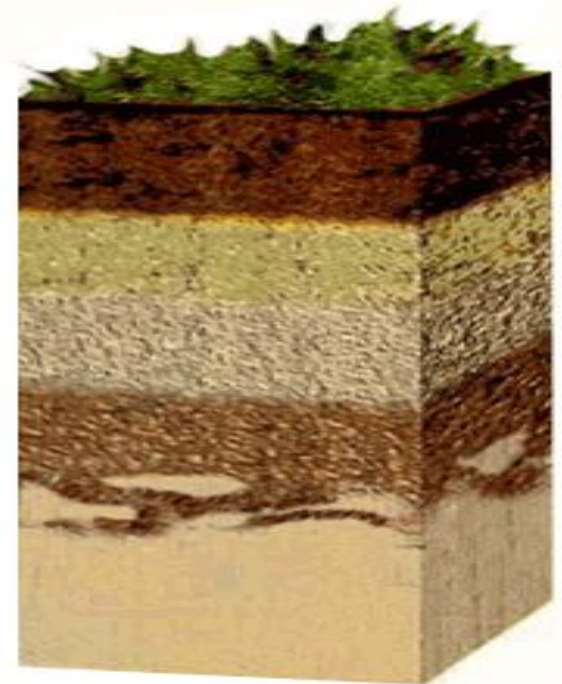
A horizon
(mineral matter
mixed with some
humus)

E horizon
(light colored
zone of leaching)

B horizon
(accumulation
of clay from
above)

C horizon
(partially altered
parent material)

unweathered
parent material



Importance of Soil as a Resource

Soil is one of the three major natural resources, alongside air and water.

- Soil acts as a principal medium of plant growth-which provide food for human
- Regulates water supplies
- Recycles raw materials and waste products
- Serves as a major engineering medium for human built structure
- Indirectly regulates the climate keeping our environment habitable

Concern regarding soil

We are concerned about soil because once the soil is lost from the field it takes more time than we have for new soil to be developed. It takes nature under the most favourable climatic conditions together with good vegetative cover 200 to 1000 years or more to build one inch of topsoil from the raw material of subsoil. If a seven inch layer of topsoil is allowed to wash away at least 1400 to 7000 years of nature's work goes to waste. Hence for all practical purposes it could be said that soil is by far the most important, basic and irreplaceable resource.

The growing degradation and loss of soil means that the expanding population in many parts of the world is pressing this resource to its limits and its absence in the environment is going to have devastating results for humanity.

Agriculture and Soil

Agriculture is very important, old and traditional type of primary economic activity. It is an economic activity conducted by Humans to grow crops and raise livestock directly from the field under their direct supervision.



Agriculture involves use of fertilizer, pesticide, irrigation etc. Agriculture depends heavily on soil quality. Intensive agriculture can also lead to the decline in the soil quality. Intensive agriculture uses high levels of complementary inputs such as irrigation, chemical fertilizers and pesticides to achieve maximum yields at the lowest possible cost.

The negative impacts of intensive agriculture may include

- Deforestation and emission of green house gases
- Soil erosion
- Soil degradation or decline in soil quality
- Over extraction of ground water
- Excess use of pesticide and fertilizer may lead to surface and ground water pollution
- Overgrazing leading to loss of biodiversity

The solution is Soil conservation and Sustainable agriculture.

Soil conservation may be defined as 'the positive tasks of land use and management so that there shall be no loss of stability, productivity or usefulness for the chosen purpose'.

The aim of soil conservation is the prevention of soil erosion so that the fertile topsoil is retained.

Strategies of soil conservation

- Changing mechanical methods - terracing in mountain areas



- Changing farming practices - crop rotation, mixed cropping



Crop rotation for 3 growing seasons

- Community solution - tree planting on slopes in and next to farming areas, in order to replace trees already cleared

Sustainable agriculture should involve the successful management of resources to satisfy changing human needs while maintaining or enhancing the quality of the environment and conserving natural resources.

- Ecologically sound
- Economically viable
- Socially & culturally appropriate
- Based on holistic scientific approach

Goal of Sustainable agriculture is

- to produce food and fiber on a sustainable basis
- Produce good-quality food
- repair the damage to the environment caused by destructive practices
- regulate environmental health
- conservation of natural resources
- economic viability
- energy conservation

Some appropriate technology in sustainable agriculture

- Improved irrigation
- Chemicals - Mixture of Organic and Inorganic fertilizers
- Mixed cropping , Crop rotation
- Natural predators
- New seeds and plant varieties
- High-yielding variety of seeds(HYVs)
- Power from living resources (biofuels, biogas)