

India Physical Environment

Chapter-22 Soils

Definition of Soil

Soil is the mixture of rock debris and organic materials which develop on the earth's surface.

Importance of Soils

1. Provide support & nutrients to the plants
2. Plants provide food and clothes are grown over the soils
3. Provide shelter to microorganisms
4. Supply nutrients to plants.

Factors Affecting Soils

The major factors affecting the formation of soil are

1. relief
2. parent material
3. climate
4. vegetation
5. life-forms and
6. time
7. human activities

Components of the soil

1. mineral particles
2. humus
3. water
4. air

Soil Horizons and Soil Profile:

If we dig a pit on land and look at the soil, we find that it consists of three layers which are called horizons.

- **‘Horizon A’** is the topmost zone, where organic materials have got incorporated with the mineral matter, nutrients and water, which are necessary for the growth of plants.
- **‘Horizon B’** is a transition zone between the ‘horizon A’ and ‘horizon C’, and contains matter derived from below as well as from above. It has some organic matter in it, although the mineral matter is noticeably weathered.
- **‘Horizon C’** is composed of the loose parent material. This layer is the first stage in the soil formation process and eventually forms the above two layers. This arrangement of layers is known as the **soil profile**.

Underneath these three horizons is the rock which is also known as the parent rock or the bedrock. Soil, which is a complex and varied entity has always drawn the attention of the scientists.

Classification of Soils

In ancient times, soils used to be classified into two main groups - Urvara and Usara, which were fertile and sterile, respectively.

In the 16th century A.D, soils were classified as below:

- **on the basis of their inherent characteristics** and external features such as 1. texture, 2. colour, 3. slope of land and 4. moisture content in the soil.
- **Based on texture**, main soil types were identified as 1. sandy, 2. clayey, 3. silty and 4. loam, etc.
- **On the basis of colour**, soil types were identified as 1. red, 2. yellow, 3. black, etc.

The **Indian Council of Agricultural Research (ICAR)** has classified the Indian soils on the basis of their nature and character as per the United States Department of Agriculture (USDA) Soil Taxonomy, which is as follows-

(i) Inceptisols (ii) Entisols (iii) Alfisols (iv) Vertisols (v) Aridisols (vi) Ultisols (viii) Others

On the **basis of genesis, colour, composition and location**, the soils of India have been classified into: (i) Alluvial soils (ii) Black soils (iii) Red and Yellow soils (iv) Laterite soils (v) Arid soils (vi) Saline soils (vii) Peaty soils (viii) Forest soils.

Alluvial Soils

Location:

Alluvial soils are widespread in the northern plains and the river valleys.

Characteristics:

1. These soils cover about 40 per cent of the total area of the country.
2. They are depositional soils, transported and deposited by rivers and streams.
3. Through a narrow corridor in Rajasthan, they extend into the plains of Gujarat.
4. In the Peninsular region, they are bound in deltas of the east coast and in the river valleys.
5. They are generally rich in potash but poor in phosphorous.
6. In the Upper and Middle Ganga plain, two different types of alluvial soils have developed, viz. Khadar and Bhangar. Khadar is the new alluvium and is deposited by floods annually, which enriches the soil by depositing fine silts. Bhangar represents a system of older alluvium, deposited away from the flood plains. Both the Khadar and Bhangar soils contain calcareous concretions (Kankars).
7. These soils are more loamy and clayey in the lower and middle Ganga plain and the Brahmaputra valley.
8. The sand content decreases from the west to east.
9. The colour of the alluvial soils varies from the light grey to ash grey. Its shades depend on the depth of the deposition, the texture of the materials, and the time taken for attaining maturity.

Black Soil

1. Black soil covers most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu.
2. In the upper reaches of the Godavari and the Krishna, and the northwestern part of the Deccan Plateau, the black soil is very deep.
3. These soils are also known as the 'Regur Soil' or the 'Black Cotton Soil'.
4. The black soils are generally clayey, deep and impermeable.
5. They swell and become sticky when wet and shrink when dried. So, during the dry season, these soil develop wide cracks.
6. Chemically, the black soils are rich in lime, iron, magnesia and alumina.
7. They also contain potash. But they lack in phosphorous, nitrogen and organic matter.
8. The colour of the soil ranges from deep black to grey.

Red and Yellow Soil

1. Red soil develops on crystalline igneous rocks in areas of low rainfall in the eastern and southern part of the Deccan Plateau.
2. Along the piedmont zone of the Western Ghat, long stretch of area is occupied by red loamy soil.
3. Yellow and red soils are also found in parts of Odisha and Chattisgarh and in the southern parts of the middle Ganga plain.
4. The soil develops a reddish colour due to a wide diffusion of iron in crystalline and metamorphic rocks.
5. It looks yellow when it occurs in a hydrated form.
6. The fine-grained red and yellow soils are normally fertile, whereas coarse-grained soils found in dry upland areas are poor in fertility.
7. They are generally poor in nitrogen, phosphorous and humus.

Laterite Soil

1. Laterite has been derived from the Latin word ‘_Later’ which means brick.
2. The laterite soils develop in areas with high temperature and high rainfall.
3. These are the result of intense leaching due to tropical rains.
4. With rain, lime and silica are leached away, and soils rich in iron oxide and aluminum compound are left behind.
5. Humus content of the soil is removed fast by bacteria that thrives well in high temperature.
6. These soils are poor in organic matter, nitrogen, phosphate and calcium, while iron oxide and potash are in excess.
7. Hence, laterites are not suitable for cultivation; however, application of manures and fertilizers are required for making the soils fertile for cultivation.
8. Red laterite soils in Tamil Nadu, Andhra Pradesh and Kerala are more suitable for tree crops like cashewnut.
9. Laterite soils are widely cut as bricks for use in house construction. These soils have mainly developed in the higher areas of the Peninsular plateau.
10. The laterite soils are commonly found in Karnataka, Kerala, Tamil Nadu, Madhya Pradesh and the hilly areas of Odisha and Assam.

Arid Soils

1. Arid soils range from red to brown in colour.
2. They are generally sandy in structure and saline in nature. In some areas, the salt content is so high that common salt is obtained by evaporating the saline water.
3. Due to the dry climate, high temperature and accelerated evaporation, they lack moisture and humus.
4. Nitrogen is insufficient and the phosphate content is normal.
5. Lower horizons of the soil are occupied by 'kankar' layers because of the increasing calcium content downwards.
6. The 'Kankar' layer formation in the bottom horizons restricts the infiltration of water, and as such when irrigation is made available, the soil moisture is readily available for a sustainable plant growth.
7. Arid soils are characteristically developed in western Rajasthan, which exhibit characteristic arid topography.
8. These soils are poor and contain little humus and organic matter.

Saline Soils

Location: Saline soils are widespread in western Gujarat, deltas of the eastern coast and in Sunderban areas of West Bengal. It can also be seen in the areas of Punjab and Haryana for excessive groundwater irrigation.

Characteristics:

1. They are also known as Usara soils.
2. Saline soils contain a larger proportion of sodium, potassium and magnesium, and thus, they are infertile, and do not support any vegetative growth.
3. They have more salts, largely because of dry climate and poor drainage. They occur in arid and semi-arid regions, and in waterlogged and swampy areas.
4. Their structure ranges from sandy to loamy.
5. They lack in nitrogen and calcium.
6. In the Rann of Kutch, the Southwest Monsoon brings salt particles and deposits there as a crust. Seawater intrusions in the deltas promote the occurrence of saline soils. In the areas of intensive cultivation with excessive use of irrigation, especially in areas of green revolution, the fertile alluvial soils are becoming saline.

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7. Excessive irrigation with dry climatic conditions promotes capillary action, which results in the deposition of salt on the top layer of the soil. In such areas, especially in Punjab and Haryana, farmers are advised to add gypsum to solve the problem of salinity in the soil.

Peaty Soils

Location: It occurs widely in the northern part of Bihar, southern part of Uttaranchal and the coastal areas of West Bengal, Orissa and Tamil Nadu.

Characteristics:

1. They are found in the areas of heavy rainfall and high humidity, where there is a good growth of vegetation.
2. Thus, large quantity of dead organic matter accumulates in these areas, and this gives a rich humus and organic content to the soil.
3. Organic matter in these soils may go even up to 40-50 per cent. These soils are normally heavy and black in colour.
4. At many places, they are alkaline also.

Forest Soils

Location: It is found widely in Himalayan region and Western Ghats region.

Characteristics:

1. Forest soils are formed in the forest areas where sufficient rainfall is available.
2. The soils vary in structure and texture depending on the mountain environment where they are formed.
3. They are loamy and silty on valley sides and coarse-grained in the upper slopes.
4. In the snow-bound areas of the Himalayas, they experience denudation, and are acidic with low humus content.
5. The soils found in the lower valleys are fertile.

Soil Degradation

Definition: Soil degradation can be defined as the decline in soil fertility, when the nutritional status declines and depth of the soil goes down due to erosion and misuse.

Characteristics:

1. Soil degradation is the main factor leading to the depleting soil resource base in India.

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2. The degree of soil degradation varies from place to place according to the topography, wind velocity and amount of the rainfall.

Soil Erosion

Definition: The destruction of the soil cover is described as soil erosion. The soil forming processes and the erosional processes of running water and wind go on simultaneously. There is a balance between these two processes.

Characteristics:

1. The rate of removal of fine particles from the surface is the same as the rate of addition of particles to the soil layer. Human activities too are responsible for soil erosion to a great extent.
2. The human population increases, the demand on the land also increases.
3. Forest and other natural vegetation is removed for human settlement, for cultivation, for grazing animals and for various other needs.

Agents of soil erosion: On the basis of their ability to remove soil and transport it, there are two agents of soil erosion-

1. Wind and
2. water

Types of soil erosion based on agents of erosion:

1. **Wind Erosion:** Wind erosion is significant in arid and semi-arid regions.
2. **Water Erosion:** In regions with heavy rainfall and steep slopes, erosion by running water is more significant. Water erosion which is more serious and occurs extensively in different parts of India, takes place mainly in the form of sheet and gully erosion.
 - a. **Sheet erosion** takes place on level lands after a heavy shower and the soil removal is not easily noticeable. But it is harmful since it removes the finer and more fertile top soil.
 - b. **Gully erosion** is common on steep slopes. Gullies deepen with rainfall, cut the agricultural lands into small fragments and make them unfit for cultivation. A region with a large number of deep gullies or ravines is called a **badland topography**. Ravines are widespread, in the Chambal basin. Besides this, they are also found in Tamil Nadu and West Bengal. The country is losing about 8,000 hectares of land to ravines every year.

Main Cause of Soil Erosion:

Deforestation is one of the major causes of soil erosion. Plants keep soils bound in locks of roots, and thus, prevent erosion. They also add humus to the soil by shedding leaves and twigs. Forests have been denuded practically in most parts of India but their effect on soil erosion are more in hilly parts of the country.

Effects of Soil Erosion and degradation:

1. As soil erosion reduces soil fertility, it is a serious problem for Indian agriculture.
2. Eroded materials are carried down to rivers and they lower down their carrying capacity.
3. It causes frequent flood.
4. A fairly large area of arable land in the irrigated zones of India is becoming saline because of over irrigation.
5. The salt lodged in the lower profiles of the soil comes up to the surface and destroys its fertility.
6. Chemical fertilizers in the absence of organic manures are also harmful to the soil. Unless the soil gets enough humus, chemicals harden it and reduce its fertility in the long run. This problem is common in all the command areas of the river valley projects, which were the First beneficiaries of the Green Revolution. According to estimates, about half of the total land of India is under some degree of degradation. Every year, India loses millions of tonnes of soil and its nutrients to the agents of its degradation, which adversely affects our national productivity. So, it is imperative to initiate immediate steps to reclaim and conserve soils.

Soil Conservation

NEED FOR SOIL CONSERVATION	METHODS TO CONSERVE SOILS
1. Large scale soil erosion	1. controlled grazing
2. Excessive use of fertilisers	2. terraced farming
3. Faulty methods of cultivation	3. ban on shifting cultivation
4. Deforestation	4. contour binding
5. Over use of land for cultivation.	5.Regulated forestry
6. Overgrazing	6. cover cropping

7. Shifting cultivation	7. mixed forming
	8. crop rotation
	9. Land use mapping according their capability
	10. Awareness of people

Government's initiatives in Soil conservation in India:

1. Experiments have been made to stabilise sand dunes in Western Rajasthan by the Central Arid Zones Research Institute (CAZRI).
2. The Central Soil Conservation Board, set up by the Government of India, has prepared a number of plans for soil conservation in different parts of the country. These plans are based on the climatic conditions, configuration of land and the social behaviour of people. even these plans are fragmented in nature. Integrated land use planning, therefore, seems to be the best technique for proper soil conservation.