



LEARNING OBJECTIVES

After completing this chapter you will be able to

- recognise the importance of soil as a natural resource.
- describe the layers that make up the soil profile.
- explain the composition and properties of soil.
- describe the different types of soil found in India.
- explain how soil is formed.
- explain how soil erosion takes place and how it can be prevented.
- explain different methods of conservation of soil.

Soil

Soil is the naturally occurring, uppermost layer of the earth and is formed from rocks and decaying plant and animal matter. The word 'soil' is derived from the Latin word '*solum*' which means 'earthly material'. The science which deals with the study of soil is called **pedology**.

SOIL AS A NATURAL RESOURCE

Soil is one of the most important natural resource. We know that we depend on plants for all our food. Land plants need soil for support, water and minerals. Healthy soil has more nutrients, air and water which help plants to grow well. Thus, life indirectly depends on soil.

Other uses of soil are mentioned below:

- ❖ Soil is a rich source of metals like iron, calcium, aluminium, magnesium and so on which are used in different industries.
- ❖ Soil is a source of clay which is used for making bricks, pottery and porcelain.
- ❖ Water that seeps through the soil is stored



Fig. 6.1 Land plants need soil for support, water and minerals.

underground as subsoil water. This water can be made available by boring wells.

SOIL PROFILE

A vertical section of soil from the surface down to the bedrock, showing different horizons, is called **soil profile**. Different parts of the world have different soil profile. Soil profile usually, shows three layers one above the other (Fig. 6.2) and is affected by climate and other factors.

A-horizon

This is the uppermost layer and is also known as **top soil**. It is soft, porous and contains lots

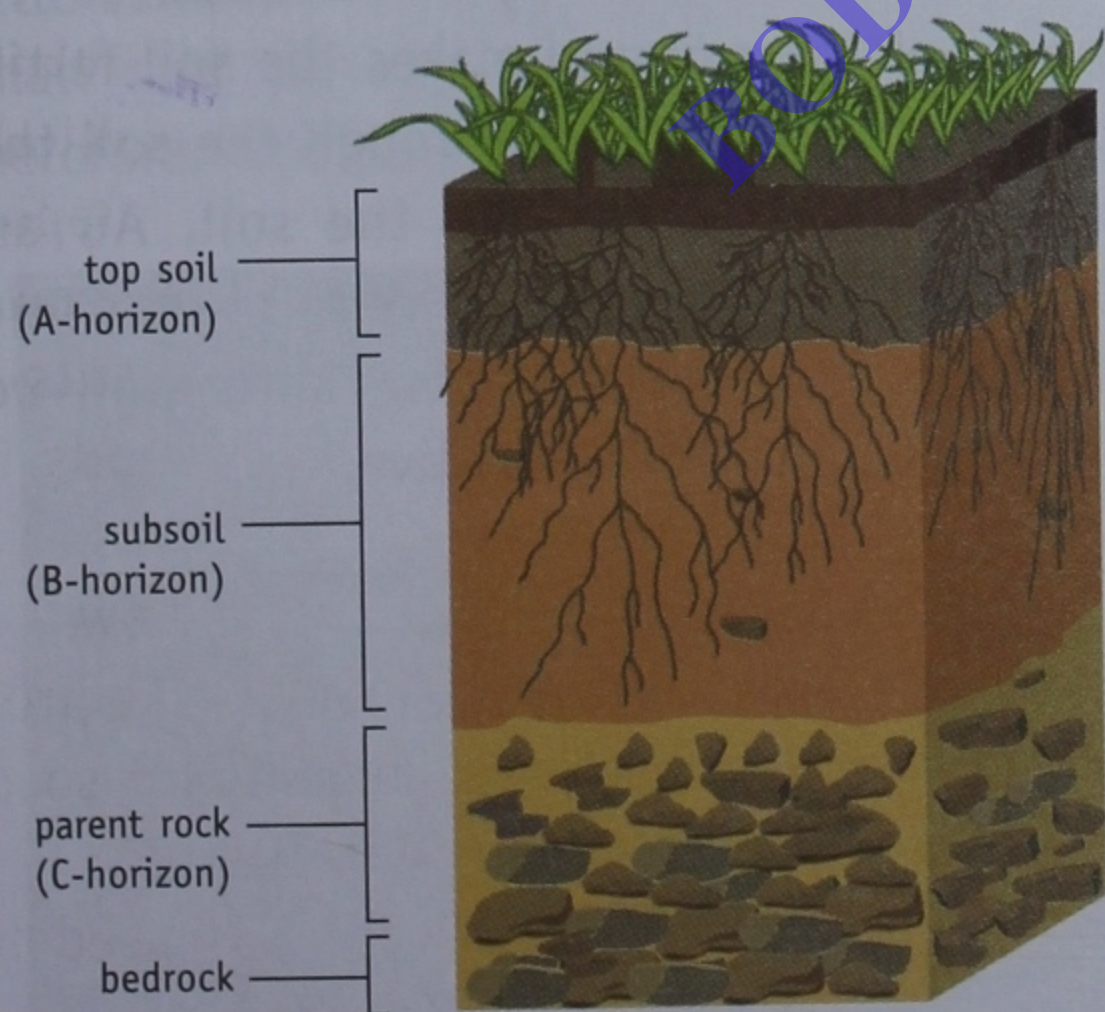


Fig. 6.2 The soil profile

of humus (dead and decaying plant and animal matter). It has a good water-holding capacity. It is also the most fertile part of the soil. Living organisms like insects, earthworms, bacteria and fungi are present in this layer.

B-horizon

It is found below the A-horizon. It is known as **subsoil** and contains sand, silt and clay. It is harder and more compact than the top soil. This layer is rich in minerals and iron oxide. Roots of tall plants normally reach the subsoil.

C-horizon

It is the third layer and consists of lumps of **parent rock** material.

Bedrock

It lies below the C-horizon and contains unweathered parent rock. It is not a part of the soil profile. It provides a base to the other three horizons.

COMPOSITION OF SOIL

ACTIVITY 1

Take some soil from your garden and put it in a beaker. Add some water and stir it. Allow it to settle down. Observe the various layers. Take soil from different sites like the roadside, a pond and a field and compare the different layers.

The lowermost layer consists of large-sized particles called **gravel**. Just above the gravel layer is a layer of **sand particles** followed by **silt** and **clay particles** (Fig. 6.3).

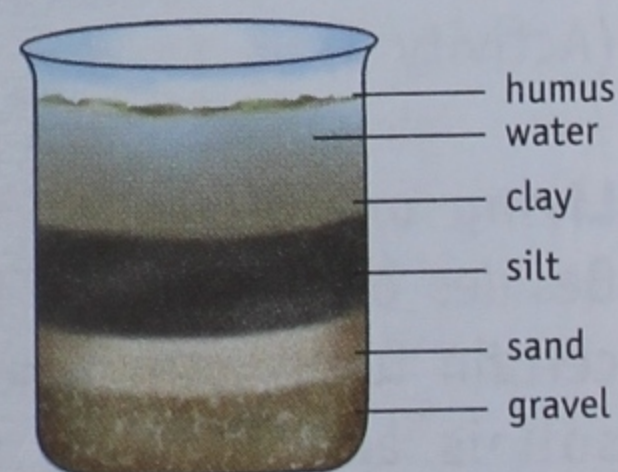


Fig. 6.3 Different particles of soil

Table. 6.1 Size of different soil particles

TYPES OF PARTICLES	SIZE
Gravel	0.2 mm – 2.00 mm
Sand	0.02 mm – 0.2 mm
Silt	0.002 mm – 0.02 mm
Clay	less than 0.002 mm

The different components of the soil are discussed below:

Inorganic matter

The soil contains inorganic matter such as clay, silica, chalk, nitrates, phosphorus, magnesium, calcium, sodium, iron and so on, which provide rich nutrients to the plants.

Organic matter—humus

Humus is the decaying remains of dead plants and animals. The decay takes place due to the action of microorganisms. During decay process, nitrogen, phosphorus and sulphur are released into the soil. This makes the soil fertile.

Air and water

The space between the soil particles is occupied by air and water. Air makes the oxygen available to the roots for respiration.

Water with minerals dissolved in it is loosely held by the soil particles and is absorbed by the root hair. The capacity of a soil to hold water depends on the type of soil particles it contains (Activity 2).

Living organisms

Besides being a home for millions of bacteria, certain fungi and some blue-green algae, the soil is also a home for many more living organisms such as millipedes, centipedes, ants and earthworms.



Fig. 6.4 Soil is a home for many living organisms.

Bacteria and fungi present in the soil play a major role in recycling of nutrients. They help in breaking down of organic matter or nutrients present in the soil. These nutrients are absorbed by plants from the soil. Some plants are eaten by animals. The nutrients in the dead remains of plants and animals are converted into nitrates by the action of decomposing bacteria and fungi and are released in the soil. These nutrients are again used by plants.

Earlier we have read that earthworms are called farmer's friends. This is because earthworms improve the quality of the soil in two ways. As an earthworm moves through the soil, it ingests soil particles. It digests bits of food in the soil. Matter that cannot digest is passed out of the body. This adds to the nutrients of the soil and makes the soil fertile. Also as earthworms move through the soil they leave tube-like passages in the soil. Air and water that are needed by plants get accumulated in these passages. Plants grow well in soil in which earthworms live.

Did you know?

1 kg of rich farm soil contains 2 trillion bacteria, 400 million fungi, 50 million algae and 30 million protozoa as well as thousands of different worms and insects.

CHECK YOUR PROGRESS 1

Fill in the blanks.

1. Land plants need soil for support, water and _____
2. The uppermost layer of soil contains lots of dead and decaying matter called _____
3. The lowermost layer consists of large-sized particles called _____
4. The space between the soil particles is occupied by air and _____
5. Bacteria and _____ present in the soil play an important role in recycling of nutrients.



Fig. 6.6 Sandy soil



Fig. 6.7 Loamy soil

TYPES OF SOIL

Soil is a mixture of particles of different sizes. The texture of the soil depends upon the size of the particles and their arrangement as well. The water holding capacity of a soil depends on the spaces between its particles.

On the basis of soil particles and its water holding capacity, soil can be classified into clayey, sandy and loamy soil.

Clayey soil

Clayey soil is largely composed of clay particles, little sand and humus. The clay particles are so small that there is hardly any air space, and therefore, this soil has a good water retaining



Fig. 6.5 Clayey soil

capacity. Such soil gets saturated with water easily and the air present between the soil particles is displaced. Thus, roots can not respire due to lack of oxygen. Therefore this soil is not very suitable for the growth of plants. A lot of minerals are however present in this soil.

Sandy soil

Sandy soil has a high percentage of sand particles and a small amount of clay. Sand particles are big and loose. The space between the particles is large enough for water to reach quickly to the lower layers, and hence, the water retaining capacity of sandy soil is low. Water as it moves down, takes away soluble minerals with it. Therefore, this soil does not support plant growth.

Loamy soil

Loamy soil contains almost equal percentage of sand and clay. It is the best soil for plant growth as it contains a lot of humus, and holds sufficient water and air between soil particles.

ACTIVITY 2

Collect some clayey soil, sandy soil, and loamy soil. Dry them. Take equal quantities of the three types of soil and put them in funnels lined with filter paper. Put the funnels in measuring cylinders. Pour 100 mL of water in each funnel. Allow the water to drip into the measuring cylinders.

Once the dripping has stopped (Fig. 6.8), compare the volume of water in each cylinder. Which cylinder has the maximum water and which cylinder has the minimum water? Can you comment on the water retaining capacity of the three types of soil? What could be the reason for the difference?

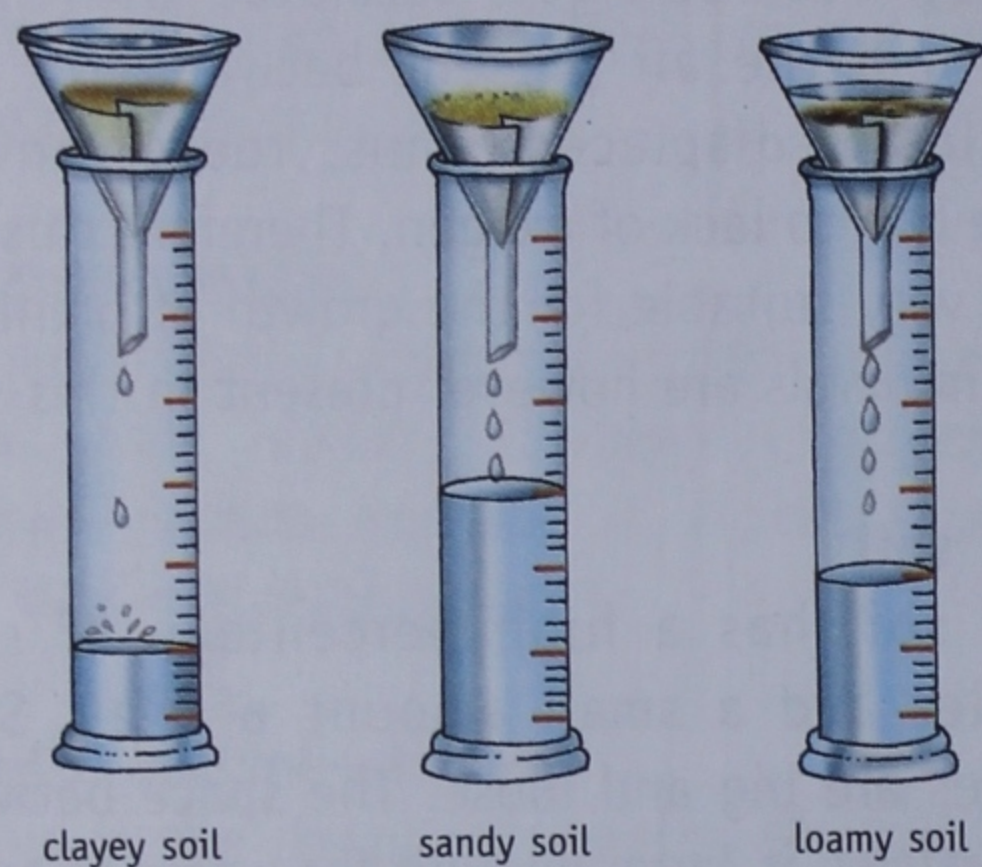


Fig. 6.8 To show the water-retaining capacity of clayey, sandy and loamy soil

TYPES OF SOIL FOUND IN INDIA

Soils found in India are broadly divided into the following types.

Red soil

Red soil is red in colour due to the presence of high percentage of red iron oxide. It contains very little humus. The water holding capacity is less. It is mostly found in interior regions of Kerala, Tamil Nadu, southern Karnataka, Andhra Pradesh and Orissa. It is good for wheat, rice, sugar cane, cotton and pulses.

Black soil (Regur soil)

Black soil is formed by weathering of volcanic rocks. This soil is rich in iron, potassium and calcium. It is suitable for growing cotton and sugar cane. Since this soil is ideal for growing



Fig. 6.9 Red soil is suitable for growing cotton and sugar cane.



Fig. 6.10 Alluvial soil is good for rice, wheat and sugar cane.

cotton, it is also called **black cotton soil**. It is found in Maharashtra and Madhya Pradesh and Gujarat.

Alluvial soil

Alluvial soil is formed by the rivers carrying very fine rock particles to lowlands. It is loamy in texture and contains a lot of humus. It is highly fertile specially for wheat, rice and sugar cane. It is found in the plains of Haryana, Punjab, Uttar Pradesh and Bihar.

Did you know?

Soil formed by volcanic eruptions contains a large quantity of minerals. It is naturally so porous that it supports lush green plants even though it has very little humus.

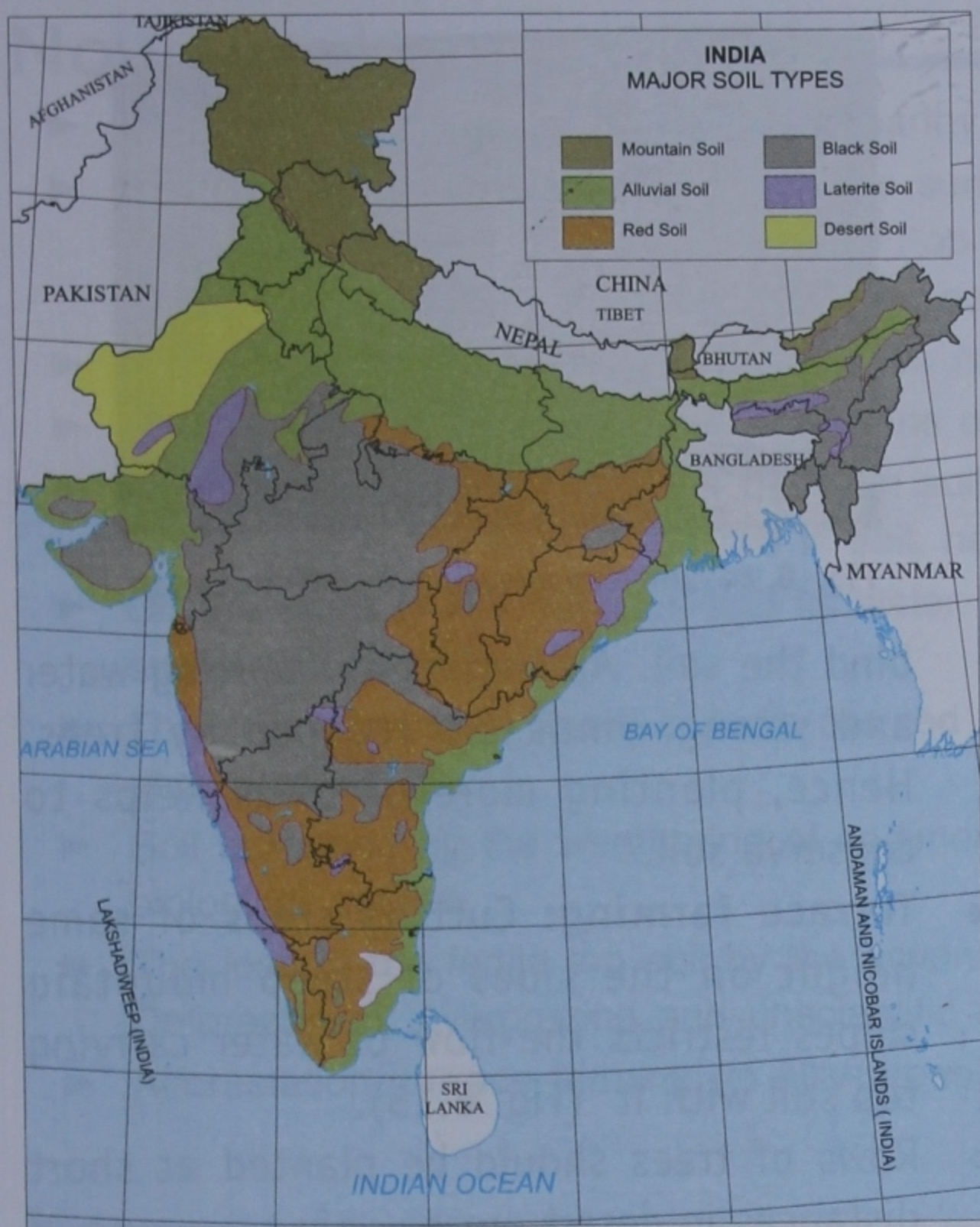


Fig. 6.11 Map of India showing six major types of soil found in India

Laterite soil

Laterite soil is a clayey soil which is red in colour due to the presence of iron. It is porous and suitable for growing tea, coffee and coconut. It is found in regions that receive heavy rainfall like parts of Tamil Nadu, Andhra Pradesh, Orissa and Assam.

Desert soil

Desert soil is coarse in texture because the fine layer on the top is blown away by the wind. The soil is dry, sandy, porous and contains salts. It has a very low content of humus and is not suitable for growing crops. It is found in Rajasthan and south Punjab.

Mountain soil

Mountain soil has a very high humus content and is therefore highly fertile. It is found in the parts of Himalayas and in north east India.

FORMATION OF SOIL

Soil is largely formed from sedimentary rocks as these rocks are widely distributed on the earth's surface. Soil formation is a very slow process. The parent rock gets disintegrated by physical, chemical and biological agents. Temperature, rainwater, running streams, ice, wind and roots of plants are the physical agents which bring about the disintegration of rocks.

- ❖ Sudden changes in temperature cause expansion and contraction of rocks. This results in cracks in rocks and over a period of time, fine particles are formed.
- ❖ Water which enters the crevices of rocks freezes at low temperature. Water expands on freezing. This results in cracking of rocks into smaller pieces.
- ❖ Continuous movement of rainwater, river water and wind also has an abrasive effect on rocks leading to break down of rocks.
- ❖ Roots of trees growing through rocks exert pressure on the rocks causing cracks in them.

Thus, breaking of huge pieces of rocks into fine particles through direct contact with atmospheric conditions is called **weathering**. Soil formation takes place by weathering of rocks.

SOIL EROSION

Very often, running water and wind carry away the top fertile soil from one place to another and the fertility of the soil is lost. This process is called **soil erosion**. Soil erosion is caused by rain, wind, deforestation, overgrazing and unscientific agricultural practices.

Soil particles are held firmly by roots of trees, and thus, rainwater can not wash away the top soil. But **deforestation** (cutting down of trees) exposes the soil and makes it loose. As a result the top soil gets easily washed away by rain or blown away by wind.



Fig. 6.12 Soil erosion by wind

In desert areas, the wind and in mountains, rain is the main cause of soil erosion (Fig. 6.12 & 6.13). Overgrazing by animals in a particular area leaves the land barren. This barren land is prone to erosion by wind and rain. The process of soil formation takes many years whereas it can get blown away in just a few minutes.

Did you know?

Plants can also be grown without soil. All they need is water, mineral nutrients and air. The cultivation of plants without soil, in sacs of water and mineral nutrients is called hydroponics.

SOIL CONSERVATION

Human beings can conserve soil, the precious natural resource by following the few steps mentioned here.

- ❖ **Afforestation:** The roots of plants and trees



Fig. 6.13 Soil erosion by water



Fig. 6.14 Soil conservation by afforestation

bind the soil. Also effects of flowing water and strong winds are reduced by trees. Hence, planting more of trees helps to conserve soil.

- ❖ **Terrace farming:** Cutting steps of same height on the sides of steep mountain slopes restricts the flow of water carrying top soil with it (Fig. 6.15).
- ❖ Rows of trees should be planted at short distances in desert areas.
- ❖ Land should not be left uncultivated or barren for long since the dry soil gets eroded easily.
- ❖ To reduce the effect of strong wind, tall trees should be grown around the field in two or three rows.
- ❖ **Crop rotation:** It is the practice of growing different kinds of crops in a given area each season. If during one season wheat is grown, in the next season pea or pulses are grown. Crop rotation helps in reducing the loss of nutrients from the soil.



Fig. 6.15 Terrace farming prevents soil erosion.

Now you know

- ▶ The soil is a mixture of broken loose earthy material and organic matter.
- ▶ Soil profile is a vertical section from the surface of the earth down to the bedrock where three layers are visible. These are A-horizon (top soil), B-horizon (subsoil) and C-horizon (parent rock). The bedrock seen below the three horizons contains unweathered parent rock.
- ▶ Soil consists of particles of different sizes namely gravel, sand, clay, silt and humus.
- ▶ Humus is the decaying and dead remains of plant and animal matter. It makes the soil fertile.
- ▶ Air and water occupy space in between soil particles. Various living organisms like bacteria, fungi, insects and worms that live in soil, help in making the soil fertile.
- ▶ On the basis of soil particles and its water holding capacity, soil can be classified into clayey, sandy and loamy soil.
- ▶ The soils commonly found in India are red soil, black soil, alluvial soil, laterite soil, desert soil and mountain soil.
- ▶ Soil is formed by the weathering of sedimentary rocks due to various physical, chemical and biological agents.
- ▶ The loss of the fertile top soil by the action of water or wind is called soil erosion. Deforestation, overgrazing and unscientific agricultural practices increase soil erosion.
- ▶ Afforestation, terrace farming (in hilly areas) and crop rotation can help to conserve soil.

Keywords

PEDOLOGY	study of soils, which includes studying of how different kinds of soil are formed and what they are made from
SOIL PROFILE	vertical section of soil from the surface down to the bedrock
SOIL CONSERVATION	to prevent the loss of top fertile soil due to erosion
PARENT ROCK	rock from which soil is formed
SOIL EROSION	erosion of top fertile layer of soil

Exercises

A. Tick the most appropriate answer.

- The soil profile consists of
 - two layers.
 - four layers.
 - three layers.
 - five layers.
- The soft, porous layer with a good water retaining capacity forms the
 - A-horizon.
 - B-horizon.
 - C-horizon.
 - bedrock.
- The layer with lumps of parent rock material is the
 - A-horizon.
 - B-horizon.
 - C-horizon.
 - bedrock.
- The largest-sized particles in soil are of
 - clay.
 - humus.
 - sand.
 - gravel.



5. The soil with the best water retaining capacity is
 - a. clayey soil.
 - b. sandy soil.
 - c. loamy soil.
 - d. humus.
6. The plains of Uttar Pradesh, Haryana and Punjab are dominated by
 - a. black soil.
 - b. alluvial soil.
 - c. desert soil.
 - d. mountain soil.
7. The soil found in Maharashtra, Madhya Pradesh and Gujarat is dominated by
 - a. alluvial soil.
 - b. desert soil.
 - c. black soil.
 - d. laterite soil.
8. Planting of more trees is called
 - a. deforestation.
 - b. afforestation.
 - c. crop rotation.
 - d. soil conservation.

B. Fill in the blanks.

1. Soil is a source of _____ which is used for making bricks, pottery and porcelain.
2. The most fertile layer of the soil is _____
3. _____ soil has the least water retaining capacity.
4. Land should not be left uncultivated for long since the _____ soil gets eroded easily.
5. Desert soil lacks in _____ due to a thin vegetation cover.
6. Breaking down of huge pieces of rocks into fine particles by the action of water and changing temperature is called _____
7. Depletion of top soil by rain or wind is called _____
8. The cutting down of trees on a large scale is known as _____

C. Write true or false for each statement. Rewrite the false statements correctly.

1. All life indirectly depends on soil.
2. Soil has both living and non-living components.
3. Humus is formed by the decay of dead plant and animal matter.
4. The water retaining capacity of soil depends on the colour of the soil.
5. Loamy soil holds sufficient water and air between soil particles.
6. Soil is mainly formed from sedimentary rocks.
7. Mountain soil is rich in humus.
8. Crop rotation is the practice of growing same kind of crop in a given area each season.

D. Define the following terms.

1. Soil profile
2. Soil erosion
3. Afforestation
4. Weathering
5. Crop rotation



E. Write short answers.

1. What is bedrock?
2. Name different types of soils found in India.
3. Which type of soil is best for plant growth?
4. Write one characteristic feature of alluvial soil.
5. What is weathering of rocks?



F. Answer in detail.

1. Why is soil regarded as one of the most important natural resources?
2. What are the different layers of soil observed in a soil profile? Draw them.
3. Why is A-horizon considered to be the most fertile layer?
4. How do earthworms make the soil fertile?
5. Why is loamy soil considered to be the best for plant growth?
6. How is soil classified on the basis of the size of particles present in it and their arrangement?
7. What is soil erosion? What are the various factors responsible for it?
8. Name the different steps that can be taken to conserve soil. How does afforestation help to conserve soil?
9. Nutrients absorbed by the plants are returned to the soil. How?

Fun to do

Stop soil erosion

1. Take two shallow trays filled with soil.
2. One tray of soil is without grass and the other one has soil with grass covering its surface.
3. Keep both the trays slightly tilted. Water them daily for 3 days. In which tray is more soil being washed away and why?

