CHAPTER 1

Introduction to Soil

Soil is a natural resource on which people are dependent in many ways. Since the birth of the soil conservation movement in the 1930s, there has been an increased interest in conserving the soil. The environmental awareness and concerns that have occurred over the past several decades have focused attention on the need to conserve soil as a fundamental part of the ecosystem. There is, however, little public understanding of the soil's complexity.

Careful observers may see soil exposed in roadbanks or excavations, and it may be noticed that the soil does not look the same in all locations (Fig. 1.1). Sometimes the differences are apparent in the few inches of surface soil that the farmers plow, but greater variations can usually be seen by looking at a cross section of the top 3 or 4 ft. (0.9 or 1.2 m) of soil. The quality and quantity of vegetative growth depends on the properties of the soil layers.

Roads and structures may fail if they are constructed on soils with undesirable characteristics. Special care must be taken to overcome soil limitations for specific engineering uses. Satisfactory disposal of human waste and livestock manure is becoming an increasing concern, particularly where soils are used as a disposal site.

Poor yields of agricultural crops and poor growth of trees may result from a mismatching of crops and soils. This mismatching may happen because the landowner has not examined the soil horizons or understood their limitations. Soil scientists study the factors necessary for proper soil management and plant growth.

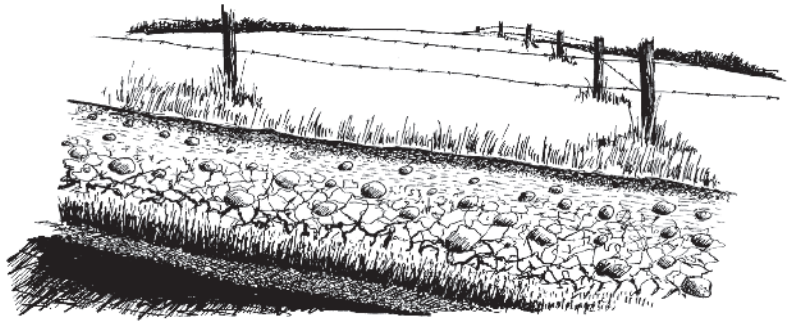
What Is Soil?

The traditional meaning of soil is that it is the natural medium for the growth of land plants. The Soil Science Society of America has published two definitions. One is "The unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants."

A more inclusive definition by the Society is "The unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows the effects of genetic and environmental factors of: climate (including water and temperature effects) and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time."

Soil Science Simplified, Sixth Edition. Neal S. Eash, Thomas J. Sauer, Deb O'Dell, and Evah Odoi.

1.1 Roadbanks can reveal the complexity of the soil.



The effect of each of these genetic and environmental factors will be discussed in Chapter 2 on soil formation.

Soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics. The differences in these properties and characteristics will be discussed in subsequent chapters. Their effect on soil management decisions is important whether the soil is to be used for crop production, in an urban setting, or for roads, dams, waste disposal, and its many other uses.

Most soil consists of fragmented and chemically weathered rock which includes sand, silt, and clay separates, and it usually contains humus, which is partially decomposed organic matter. Soil is very diverse over the face of the earth, and it varies considerably. If properties of a soil are known, the soil can be properly managed, and it will serve quite well for the purpose for which it is used.

Nature and Uses of Soil

Soil is a medium in which plants are grown for food and fiber. It is fortunate that over most of the land area of the earth, soil covers bedrock to a considerable depth. If there were no soil, the continents would be wastelands of barren rock. In soil, seeds germinate and plants grow as they obtain water and nutrients from the soil. Crops of the fields and forests produce food and fiber.

Soil gives mechanical support for plant roots so that even tall trees stand for decades against strong winds. Soil also physically supports structures such as houses, buildings, sidewalks, streets, and highways. Sometimes the properties of soils are undesirable and buildings and pavement will crack due to the instability of the underlying soil. Abandoned roads may be buried by soil carried upward by ants, earthworms, and other creatures.

In intertropical regions, millions of people live comfortably in places built chiefly from locally excavated soil. Such earthen houses are common in West Africa (Fig. 1.2). A compound earthen dwelling for an extended family may be quite an impressive structure.

1.2 Earthen houses are common in West Africa.

The adobe houses of the southwestern United States and the pioneer sod houses of the prairies are other examples of earthen houses. Modern earth-sheltered homes are shown with pride by the owners and builders. For maximum insulation, houses often feature an earthen embankment covering all but the side exposed to the sun.

Soil is involved in several processes in the hydrologic cycle. Water in the form of rain, dew, fog, irrigation, or snowmelt may move into the soil (infiltrate) or evaporate or run off of the soil surface into the area drainage system into lakes or streams. The water that infiltrates into the soil may evaporate or be utilized by plants. It may be used by the plants to form compounds or it may be transpired from the leaves back into the atmosphere. If there is more water than the soil will hold, it may percolate downward to become part of the groundwater reservoir and eventually become part of streams, rivers, and springs.

Many organic and inorganic pollutants in wastewater are sorbed as they pass through the soil, thereby partially cleansing the groundwater. If potential pollutants that are very soluble are added to the soil, they may be carried by the soil water into the groundwater to our detriment.

Soil is an air-storage facility. Plant roots and billions of other organisms living in the soil need oxygen. The pore system in soil provides access to air, which moves into and drawn out of the soil by changes in barometric pressure, by turbulent wind, by the flushing action of rainwater, and by diffusion. Some plants, such as rice, have the capacity to conduct oxygen into waterlogged soil. Soil air contains considerable amounts of carbon dioxide.

Soil is even useful as a mineral supplement for people. In some impoverished African countries, selected types of soil containing high calcium, for example, have been used as a special food supplement. Specifically, pregnant women and their babies have benefited from the mother's ingestion of soil from termite mounds that are enriched with calcium. By using this natural resource, these women may have adequate calcium in their systems.

Soil accepts back that which came from it. When plants die, it is not long before organisms that cause them to decompose will be active and the plant will eventually become a part of the soil. Even huge logs on the forest floor soon disappear (Fig. 1.3). Animals that live in the wild as well as other forms of life also return to the soil when they die. Society

1.3 Living organisms sooner or later become a part of the soil once again.

produces vast amounts of waste of every size, shape, and description, which is often buried in landfills where it will decompose if it is organic.

Soil is beautiful; it is an aesthetic resource. People may become fond of their native soil, whether it is black and brown or red and yellow. There is a rainbow of various hues of soil under our feet.

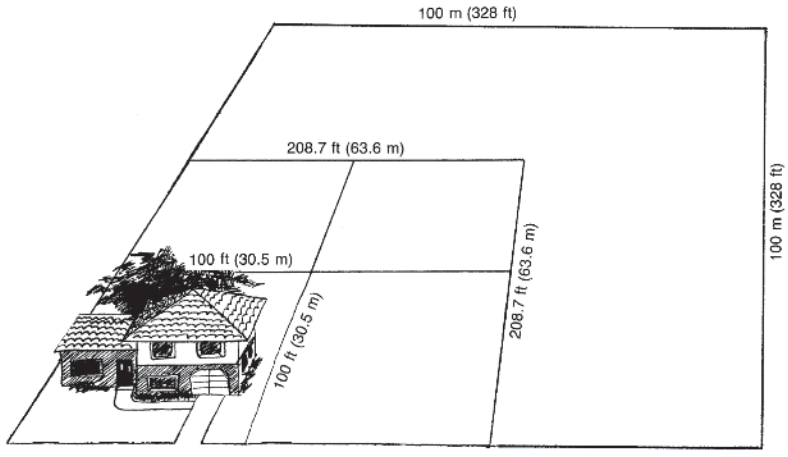
Changes in both soil and vegetation through the seasons are observed with great interest. Some soils form wide cracks in dry seasons and swell when the rains return. Frost action may create little ice pillars that lift the surface of the ground in winter. The smell of freshly tilled soil seems good to farmers and gardeners as they plant their crops with high expectations for an abundant harvest. Some people love their native soil so much that even today they still perform the ancient ritual of kneeling to kiss it when they return home.

How Big Is an Acre? A Hectare?

Land measurements in the United States are in the English system while for most of the rest of the world the metric system is used. The principal measure of land in the English system is the acre while the hectare is used in the metric system. One acre equals 0.4047 ha; hence, an acre is only about 40% the size of an hectare. An acre has 43,560 sq ft, while a hectare contains 107,628 sq ft.

In the United States, soil amendments are usually applied in units of pounds (or tons) per acre. In the rest of the world, applications are usually in metric units of kilograms (or metric tons) per hectare. Pounds per acre closely correspond to the metric units of kilograms per hectare. Tons per acre closely correspond to metric tons per hectare. Loss of soil by erosion is rated in tons per acre.

1.4 An acre is 208.7 ft on a side; a hectare is 328 ft on a side.



Comparing a house lot size to an acre will give a perspective on the size of an acre. Most house lots will be approximately 10,000 sq ft in size (about one-fourth of an acre), whereas an acre has 43,560 sq ft. See Figure 1.4 for a perspective on these units of measurements.