Lesson 1: Importance of Soil

What is Soil?

"Soil" is a common word that people use every day. It has several meanings and may be used in various ways. As a transitive verb it means "to make dirty," for example, to soil dishes or clothing. The noun "soil" is derived from the Latin word *solum,* which means "floor" or "ground." The farmer has a more practical conception of soil, because it is the medium in which crops grow. The civil engineer, on the other hand, looks at soil as the building material which supports foundations, roads, or airport runways.

Most people do not think about the soil very much. They really do not know what it is made of and where it comes from. It is just "ground" or "dirt." This reference will describe the origins of soil, its composition, and much more.

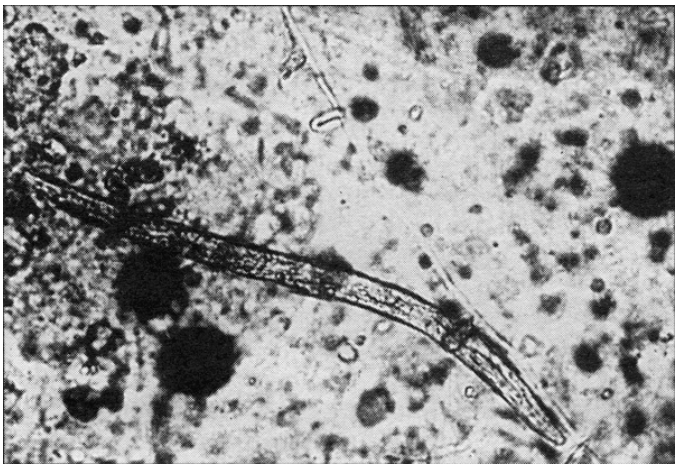
Definition

> ***Soil*** *is a living, naturally occurring dynamic system at the interface of air and rock. Soil forms in response to forces of climate and organisms that act on parent material in a specific landscape (topography) over a period of time.*

Soil scientists prefer this definition because each key word says something important about the soil. Why *living?* The soil is living because it is full of living organisms: large and small roots, animals, insects, and millions of microscopic fungi and bacteria. See Figure 1.1. Equally important are the decaying remains of plants and animals. They form organic matter, or **humus**, which is vital for good soil **tilth** (tillage or physical condition of the soil) and productivity.

Dynamic means that the soil changes all the time. Missouri soils may change from very wet in the winter to very dry in the summer. Even when irrigation is used, the amount of water in soil can vary widely. The organic matter of the surface soil increases when crop residues are worked in and decreases if the soil is not replenished with fresh plant materials. Soil nutrients increase as soil minerals break down. They decrease as water moving through the soil carries them away. Even soil acidity, or pH, changes seasonally.

Figure 1.1 – Microscopic Worm



Living, dynamic soil. The microscopic worm shown is called a nematode. A fungus (left) is attacking and invading the nematode.

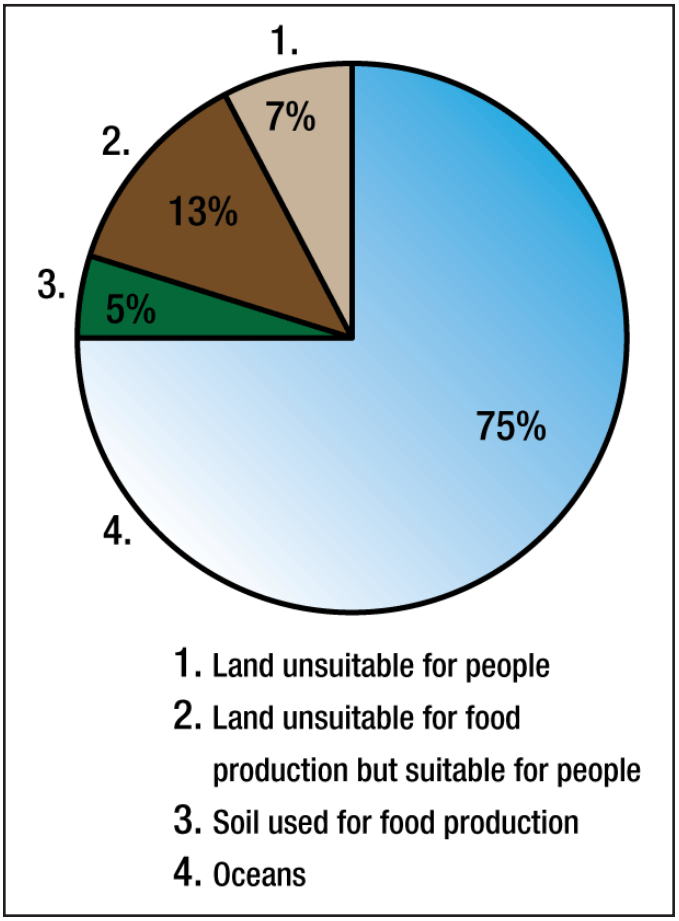
The word *system* means that all parts of the soil work together to make up the dynamic whole. A change in one part may cause changes in many parts.

The word *interface* stresses the idea that soil is indeed a very thin rind at the earth's surface. When air meets rock, especially if the air is warm and the rock is moist, the rock begins to change. Some changes are physical. Physical changes break rocks down into smaller pieces. Other changes are chemical. Chemical changes destroy some of the original minerals (primary minerals) and create new ones (secondary minerals).

Physical and chemical changes are called **weathering**. Weather occurs primarily within the first few feet of the earth's surface. Plate 1 (p. 50-A) illustrates a highly weathered soil. Between 2 and 2.5 feet below the surface lies a thin layer of weathered rock remnants not fully changed into soil.

Now consider the size of the earth. The distance from the surface to the center of the earth is about 4,000 miles. Thus, 10 feet of weathered rock out of 4,000 miles is something less than .00005 percent of the thickness. Soil does indeed occur at the point of contact between the earth and the atmosphere. See Figure 1.2.

Figure 1.2 – Areas of the Earth's Surface



Reasons for Studying Soil

Proper Use and Protection

Soil is an essential natural resource, so it is important that people know how to properly use and protect it.

Without a doubt, these are the most important reasons for studying soil. Soil is studied because the characteristics of a soil determine its potential uses and limitations. People depend on soil: it is expected to produce crops, support buildings and highways, grow trees for forests, provide places for recreation and wildlife habitat, and be a safe place for disposal of wastes.

Resource that Supports Life

Unlike plants, people cannot manufacture their own food from the four primary resources of soil, air, water, and sunlight. Instead, people depend completely on green plants, which take nutrients and water from the soil and combine them with air and sunlight to provide the food supply for people. Plants convert carbon dioxide into the oxygen that people breathe.

People eat garden fruits and vegetables and products made from plants such as corn, wheat, and rice. However, when people drink milk and/or eat meat products such as beef, pork, and chicken, the nutrients that originally came from plants (such as legumes and warm- and cool-season grasses) were consumed by these animals and indirectly passed on to people. Even fish depend on plants that grow in the sea, using nutrients that have been washed out of the soil and carried to the sea in rivers and streams. People study the soil, then, to increase their understanding of the resource that supports their life. Figure 1.3 illustrates human dependence on the soil.

Soil Composition

Some people study soil because they are just curious about this unique and fascinating natural resource. When people dig a hole or scrape off a road cut, they discover right away that there is a lot more to the soil than just the top 8 to 10 inches. Soil scientists, in fact, study the soil to a depth of 5 to 6 feet or deeper. They see distinct layers, or **horizons**, in the soil. Together, the horizons make a soil profile.

The horizons in a soil profile are described in terms of their properties. Some properties, such as color and root abundance, can be determined by sight. Other properties, such as structure, require both sight and touch, while texture requires a keen sense of touch.

Proper Management

Through the study of soil, people can learn how to tailor management practices to the specific needs of each kind of soil. Wet soils, for example, need artificial drainage for crop production. The correct way to drain them depends on just how wet and clayey they are. Many soils require irrigation for maximum productivity. Other soils have a very serious erosion hazard. The proper choice of conservation practices depends, in part, on the texture

of the surface horizon, and the steepness and length of the slope.

The student, too, can learn how to determine the important properties of soil horizons. Students will be able to make a number of important decisions about drainage, irrigation, crop selection, erosion control practices, areas for building site development, and much, much more.

Soil Differences

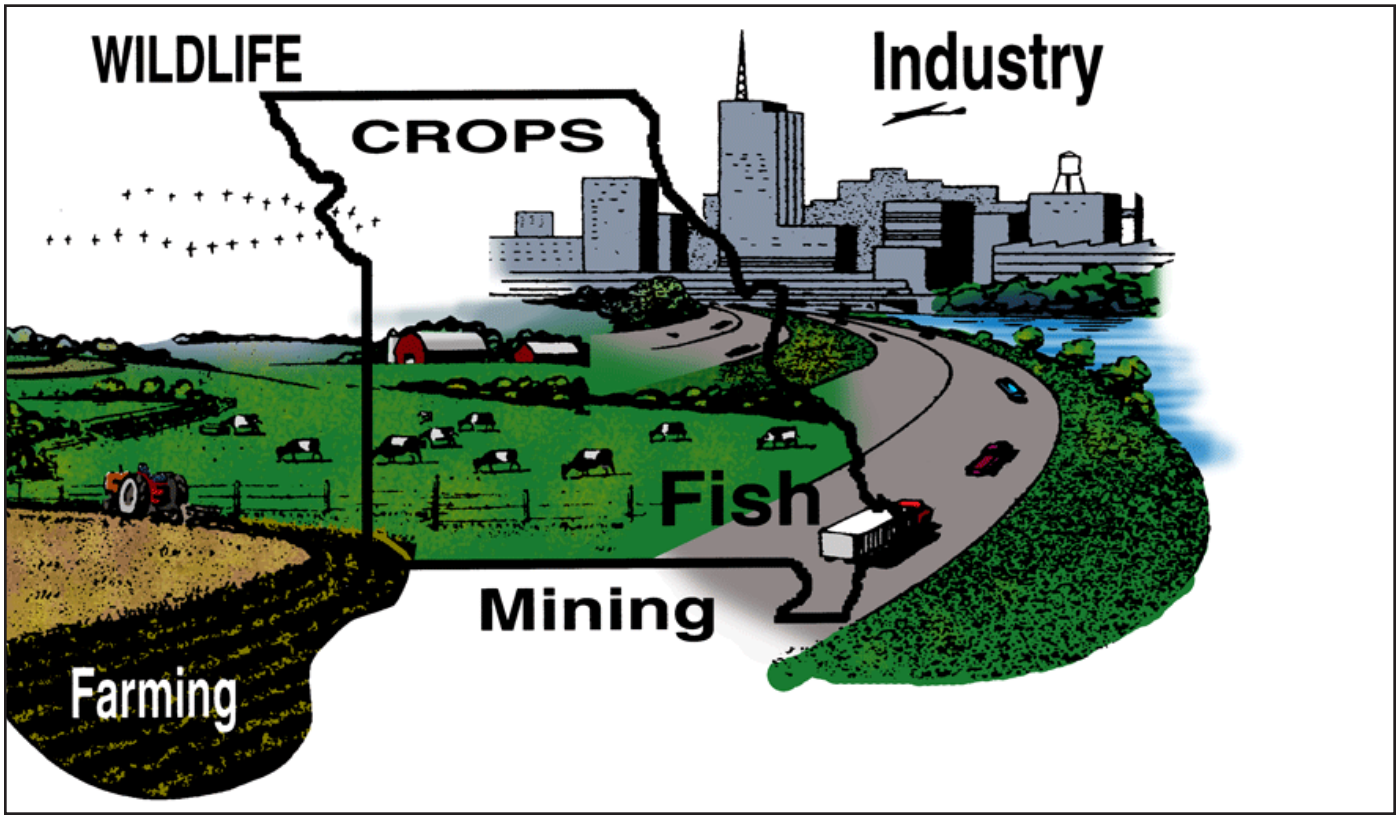
Another important reason for studying soil is to find out how soils differ. Missouri alone has nearly 1,000 different soils, ranging from very deep to very shallow, clayey to sandy, wet to dry, and nearly level to very steep. No two soils are exactly alike, just as there are no two snowflakes or fingerprints that are exactly alike. Some of the differences in soils are so slight (like variations in thickness, percent of organic matter of the surface layer, or the amount of clay in the subsoil) that it is hard to tell them apart except under close examination. Some differences are significant, such as the difference between a shallow soil that is 10 inches to bedrock (the solid rock layer under the soil) compared to one that is more than 72 inches to bedrock, or a soil containing 25 percent clay compared to a soil containing 60 percent clay.

It is important to study the soil and note its properties before beginning a construction project or planting a crop. If soil properties are unknown, the results could be disastrous. Some examples:

- ◊ It is nearly impossible to construct a basement or a septic tank filter field in bedrock.
- ◊ Soils containing a high percentage of clay cause basements and highways to crack.
- ◊ Clay soils are difficult to till and crops do not grow well in them.
- ◊ Soils formed in kaolinite clay generally do not hold water for farm ponds.
- ◊ Shallow soils will not produce adequate crop production because of the lack of available water.

Even a person unfamiliar with soils can sometimes detect these differences. There are as many differences in the

Figure 1.3 – Human Dependence on Soil



soil as there are different soil types in Missouri. Soil maps made by trained soil scientists are available for most of the land in the state. But even with soil maps, on-site evaluation is needed for very small tracts used for building sites and sanitary facilities.

Career Opportunities in Soil Science

Soil science professionals have a wide array of career opportunities in areas such as agricultural production, natural resources, and environmental sciences.

In the agricultural production industry, soil scientists can serve as farm managers, land specialists for banks, and technical representatives for agricultural chemical companies and fertilizer firms. Soil scientists can also hold positions in government and private research institutions.

Soil scientists may serve the agricultural and natural resource sectors through public service agencies such as the Natural Resources Conservation Service, the U.S. Forest Service, the Department of Natural Resources, the Department of Conservation, and the Highway and Transportation Department. Soil scientists may also serve land based recreational industries as managers of golf courses, parks, and public gardens.

The environmental science area can be served by soil scientists working for government agencies and private consulting firms in areas such as solid waste, wastewater management, reclamation of drastically disturbed lands, and water quality issues.

Summary

All life depends on the soil resource. People must study the soil so they can learn how to protect it for future use. There is plenty of good soil on this planet as long as people care for it properly. But if people do not protect it properly (by letting it erode, compacting it, or mining it), it will fail to support life.

Farmers are the primary stewards of the soil, for they are the tillers of the land. Everyone, however, shares the responsibility to help protect this valuable resource. If people manage the soil properly, it will continue to nourish the human race for generations to come. If people do not care for it, civilization is threatened. Students need to study the soil to learn about its properties and behavior, so they can manage it wisely and do their part as stewards of the land.

In this chapter, soil is defined, and several reasons for studying the soil are given. Soils can vary greatly, depending on many factors. Some of these differences are noted. Suggestions are made for career opportunities in soil science.

Credits

Huddleston, J. Herbert, and Gerald F. Kling. *Manual for Judging Oregon Soils.* Corvallis: Oregon State University Extension Service, 1984.