In a letter sent to governors on February 26, 1937, President Franklin D. Roosevelt said, “A nation that destroys its soils, destroys itself.” His words were wise. It can take hundreds of years for soil lost from fields to be replaced. Soils contaminated with chemicals are not easily cleaned and to do so is costly.

**Objective:**

- Explain soil degradation and its causes.

**Key Terms:**

- Alkalization
- Compaction
- Construction
- Deforestation
- Desertification
- Soil contamination
- Soil degradation
- Salinization
- Water logging

**Soil Degradation and Its Causes**

**Soil degradation** is a lowering of the quality or productivity of soil. Soil degradation results from construction, contamination, and erosion. Minimizing soil degradation is important in maintaining a good environment.

**Construction** practices are a leading cause of soil degradation, particularly in urban areas. Construction is the building of roads, houses, offices, factories, and other structures. In the process of building, the land is altered and soils degraded.
Soil is degraded in several ways on construction sites. Construction degrades the soil by replacing productive land with structures. Soil degradation results when the soil is left exposed to the forces of erosion. Soil on construction sites is also degraded by compaction.

In a typical scenario, large equipment is used to remove topsoil from a construction site. Usually, the topsoil is stockpiled in a large mound. The topsoil is either kept to be spread on the site when construction is completed or it is sold. In the process, the weight of heavy equipment compacts the soil. Compaction squeezes the soil particles together and destroys the soil structure. Another problem is subsoil and parent material, which have low fertility, being regularly excavated and spread on the surface of the land. The subsoil compacted from the heavy equipment is covered with a thin layer of the stockpiled topsoil.

CONTAMINATION

Soil contamination results when chemicals, oil, and other substances are spilled or leak into the land. Dumps, mines, and factories are sources of contaminants. Soil may also be contaminated through agricultural practices, such as excessive fertilizer applications, misuse of pesticides, and incorrect irrigation practices. Some contaminants soak into the soil and destroy its ability to support plant growth. Other materials may pass through the soil and enter the ground water from which some water supplies are drawn.

Contaminated land can be reclaimed at great expense. Often it involves removing contaminated soil and covering what remains with non-contaminated soil. Research is being conducted whereby certain plants are grown in the contaminated soil and absorb the contaminants. The plants are then removed along with the contaminants.

EROSION

Soil erosion is the process by which soil is moved by wind, water, or other natural actions. When soil is moved, it may pollute water or air. Soil erosion results from both natural and human actions.

Natural Erosion

Natural erosion occurs on land not disturbed by humans. It shapes the earth’s landscape by rounding off mountains and filling in valleys. Rivers carry sediments and deposit them on flood plains and in deltas. Alluvial deposits form new, highly fertile soils. Some of the most
Fertile areas today are due to wind erosion that carried loess from material left by retreating glaciers.

**Accelerated Erosion**

Certain human actions speed the rate of erosion. For example, construction and agricultural practices expose the soil to forces of erosion. The exposed soil is washed away during rainfall and blown away by wind. This increased rate of erosion is called accelerated erosion. In many places, soil is being lost much faster than it is being formed. As soil is lost to erosion, fertility levels and agricultural productivity drop.

**OTHER CAUSES OF SOIL DEGRADATION**

Soil may suffer degradations from sources other than construction, contamination, and erosion. Other causes of soil degradation include bad irrigation practices, overuse of soils, pollution, desertification, and compaction.

**Irrigation Practices**

Growing problems with agricultural soils are associated with incorrect irrigation practices. Salinization, alkaliization, and water logging are three problems. **Salinization** is an accumulation of soluble salts. A buildup of soluble salts in growing media damages plant roots. **Alkaliization** is an accumulation of exchangeable sodium. Alkali soils behave like clay soils. They are sticky when wet, usually crusty on the surface, and, when dry, become hard. **Water logging** is excessive watering that causes the soil to be saturated.

**Overuse of Soils**

Degradation results when crops are grown and harvested without the replacement of mineral nutrients and soil organic matter. Soils overused in this way are “mined” of nutrients. As fertility drops, soil organic matter is lost and soil structure deteriorates.

**Pollution**

Soils polluted with chemicals, industrial waste, human waste, and improperly handled livestock waste are considered degraded. Accumulation of heavy metals, such as cadmium and mercury, can leave soils unsafe for agricultural purposes. Processed sewage sludge should not be used to fertilize soils for the production of food, as it contains heavy metals.
Desertification

Deforestation, or the removal of trees from forested lands, is responsible for soil degradation. Deforestation, overgrazing, and other practices that remove productive plant cover lead to a condition called desertification. Desertification is most common in regions of the world where rainfall is limited. As desertification progresses, humus content declines and levels of fertility drop. The surface soil is exposed and becomes subject to erosion.

Compaction

Compaction is the packing of soil particles tightly together. It can occur after years of tillage with heavy machinery. Soil is particularly vulnerable to compaction when it is wet. Compaction damages the soil structure. Plant growth is reduced, organic matter drops, permeability is lost, and runoff increases.

LIMITING SOIL DEGRADATION

Soil degradation can be limited by managing soil quality. Different soil types and land use call for different practices to enhance soil quality. Six soil quality management components include organic matter, minimum tillage, efficient management of pests and nutrients, limiting soil compaction, maintaining ground covers, and diversifying cropping systems.

Organic Matter

Adding new organic matter to the soil every year is regarded as one of the most important ways to improve and maintain soil quality. Organic matter improves soil structure, enhances water and nutrient-holding capacity, protects soil from erosion and compaction, and supports a healthy community of soil organisms. Some practices that increase organic matter include leaving crop residues in a field, using low or no tillage systems, choosing crop rotations that include high residue plants, growing cover crops, applying manure or compost, and mulching.

Minimum Tillage

Excessive tillage should be avoided. Tillage leads to the loss of organic matter. Minimizing tillage reduces organic matter losses and protects the soil surface with plant residue. Tillage has value in agricultural production. It is used to loosen surface soil, prepare seedbeds, and control weeds and pests. At the same time, tillage can damage soil
structure, speed the decomposition and loss of organic matter, increase the threat of erosion, destroy the habitat of helpful organisms, and cause compaction.

**Efficient Management of Pests and Nutrients**

Efficient management of pests and nutrients is important. Pesticides and chemical fertilizers have valuable benefits. However, they can harm non-target organisms and pollute water and air if they are mismanaged. Pest and nutrient management begins with testing and monitoring soil and pests. Chemicals should be applied only when necessary, at the right time, and in the right amounts. Also, non-chemical approaches to pest and nutrient management, such as crop rotations, cover crops, and manure management, should be used.

**Limit Soil Compaction**

Soil compaction should be prevented. Compaction reduces the amount of air, water, and space available to roots and soil organisms. The causes of soil compaction are repeated traffic, heavy traffic, or traveling on wet soil. Compaction of deep soil by heavy equipment is difficult, if not impossible, to remedy, so prevention is essential.

**Maintain Ground Covers**

Ground cover provides a number of benefits. Bare soil is prone to wind and water erosion and to drying and crusting. Ground cover protects soil from erosive forces, provides habitats for larger soil organisms, such as insects and earthworms, and can improve water availability. Ground can be covered by leaving crop residue on the surface after harvest or by planting cover crops. Cover crops provide organic matter, continuous cover, and food for soil organisms. Ground cover must be managed to prevent problems. It can delay soil warming in spring, provide harbor for diseases, and result in excessive buildup of phosphorus at the surface.

**Diversify Cropping Systems**

Diversity of cropping systems is beneficial for a number of reasons. A variety of cultural practices can reduce weed and disease pressures. Different types of plants contribute different types of residue to the soil. An assortment of soil organisms can help control pest populations. Diversity can be increased by using buffer strips, small fields, or contour strip cropping. Diversity over time can be increased by using long crop rotations. A varying of the type of vegetation increases the diversity of insects, microorganisms, and wildlife.

**Summary:**

Soil degradation is a lowering of the quality or productivity of soil. Soil degradation results from construction, contamination, and erosion.

Construction degrades the soil by replacing productive land with structures, leaving soil exposed to the forces of erosion and compaction. Large equipment compacts soils. Topsoil may be removed and subsoil brought to the surface.
Soil contamination results when chemicals, oil, and other substances are spilled or leak into the land.

Soil erosion results from both natural and human actions. Natural erosion shapes the earth’s landscape by rounding off mountains and filling in valleys. Accelerated erosion results from human actions that speed the rate of erosion.

Incorrect irrigation practices, overuse of soils, pollution, desertification, and compaction are other causes of soil degradation.

Six soil quality management components that can limit soil degradation include organic matter, minimum tillage, efficient management of pests and nutrients, limiting soil compaction, maintaining ground covers, and diversifying cropping systems.

**Checking Your Knowledge:**

1. What is soil degradation?
2. What are three primary causes of soil degradation?
3. How do natural erosion and accelerated erosion differ?
4. How can irrigation practices lead to soil degradation?
5. What are six soil quality management components that can limit soil degradation?

**Expanding Your Knowledge:**

As you travel around your community, take note of some causes of soil degradation and practices being employed to reduce degradation. Some things to look for are tillage practices, lack of ground cover, construction sites, heavy equipment, windbreaks, grass waterways, and the use of silt fences.

**Web Links:**

- The Scoop on Dirt
  [http://www.emagazine.com/view/?3344](http://www.emagazine.com/view/?3344)
- Restoring the Land
- Human-Induced Soil Degradation
  [www.fao.org/docrep/003/w2612e/w2612eMap12-e.pdf](http://www.fao.org/docrep/003/w2612e/w2612eMap12-e.pdf)
- Sustainable Soil Management