English
For The Students Of
Soil Science

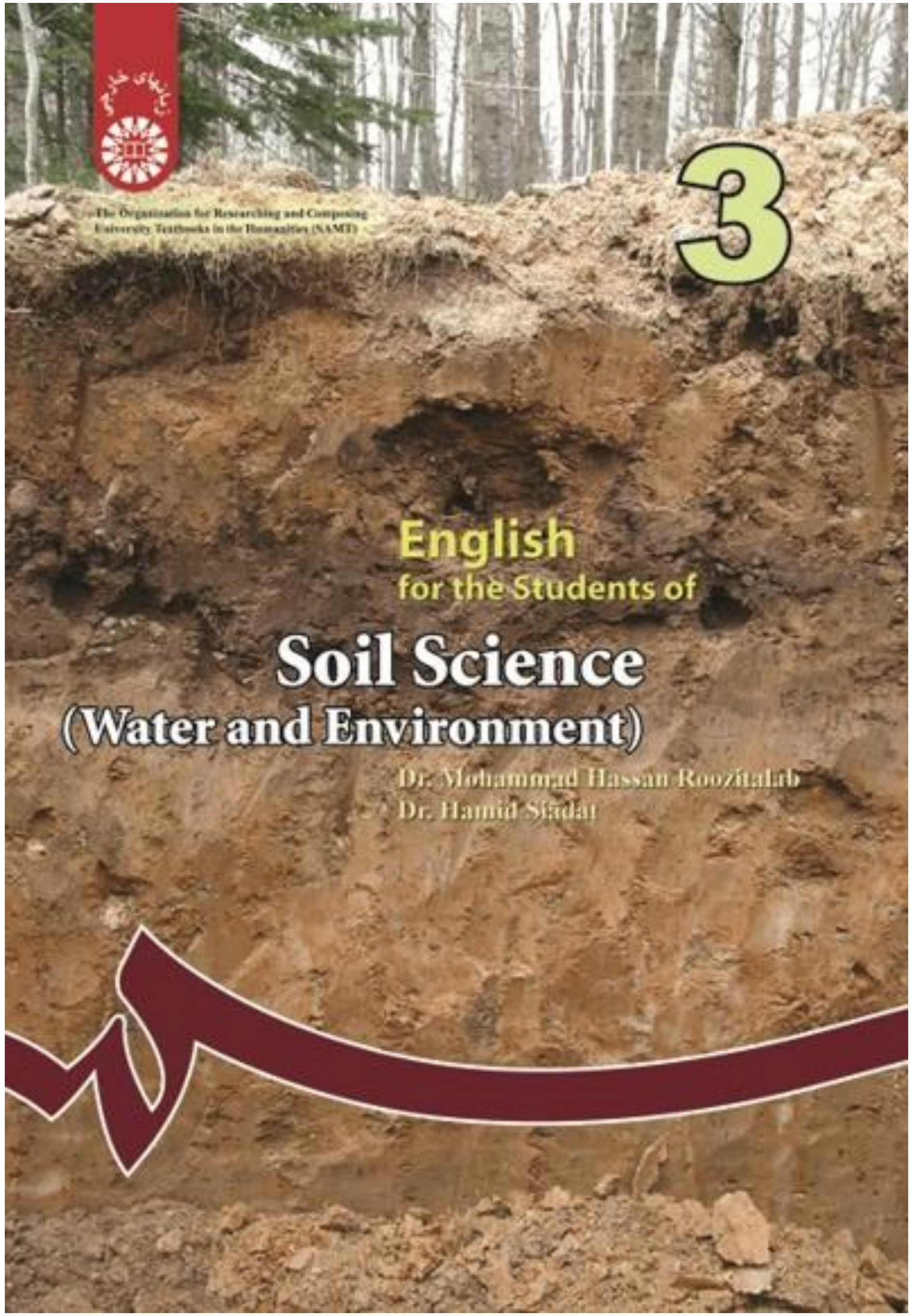
•Soil

- (i) 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.
- (ii) The unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature eff ects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.

- Absorption: Uptake of matter or energy by a substance
- Acid soil: Soil with a pH value less than 7.0.
- Acidification: Process whereby soil becomes acid ($pH < 7$) because acid parent material is present or in regions with high rainfall, where soil leaching occurs. Acidification can be accelerated by human activities (use of fertilisers, deposition of industrial and vehicular pollutants).
- Adsorption: Process by which atoms, molecules or ions are retained on the surfaces of solids by chemical or physical bonding.
- Aeration of soil: Amount of air-filled pores in the soil, expressed as the volume difference between total porosity and actual soil moisture. Optimum soil aeration is 30% but strongly depends on the structure and packing state of soil particles; 15–20% is normally satisfactory for the growth of grasses and cereals; below 10% is not good for plant growth.

- Aggregate: Soil aggregate consisting of two or more soil particles bound together by various forces.
- Aggregation: Process whereby primary soil particles (sand, silt, clay) are bound together, usually by natural forces and substances derived from root exudates and microbial activity. Soil aggregates are arranged to form soil peds, units of soil structure, classified by size, shape (platy, prismatic, columnar, angular, subangular, blocky, granular…) and grade (single-grain, massive, weak, moderate, strong). From an agronomical point of view, the most important soil aggregates are in range 3 – 1 mm.
- Anion: Particle with a negative charge. See also ion, cation.
- Anion exchange capacity: Sum of exchangeable anions that a soil can adsorb. Usually expressed as centimoles, or millimoles, of charge per kilogram of soil (or of other adsorbing material such as clay).
- Arable land: Agricultural land that is cultivated by ploughing, usually to 20 or 30 cm depth. More than 30 cm represents deep ploughing.

- Black Earth: Term synonymous with Chernozem used (e.g. in Australia) to describe self-mulching black clays.
- Calcification: Process whereby the soil is kept sufficiently supplied with calcium to saturate the soil cation exchange sites.
- Capillary water: Water in capillary pores influenced by forces that hold water in soils against a tension usually greater than 60cm. Capillary water can move upwards against gravity.



The Organization for Researching and Composing University Textbooks in the Humanities (SAMT)

3

English for the Students of Soil Science (Water and Environment)

Dr. Mohammad Hassan Roozitalab
Dr. Hamid Siadat

Lesson 2

Modern Concept of Soil

Soil is 'the collection of natural bodies in the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors. Its upper limit is air or shallow water. At its margins it grades to deep water or to barren areas of rock or ice. Its lower limit to the not-soil beneath is perhaps the most difficult to define. Soil includes the horizons near the surface that differ from the underlying rock material as a result of interactions, through time, of climate, living organisms, parent materials, and relief. In the few places where it contains thin cemented horizons that are impermeable to roots, soil is as deep as the deepest horizon. More commonly soil grades at its lower margin to hard rock or to earthy materials virtually devoid of roots, animals, or marks of other biologic activity. The lower limit of soil, therefore, is normally the lower limit of biologic activity, which generally coincides with the common rooting depth of native perennial plants'.

The 'natural bodies' of this definition include all genetically related parts of the soil. A given part, such as a cemented layer, may not contain living matter or be capable of supporting plants. It is, however, still a part of the soil if it is genetically related to the other parts and if the body as a unit contains living matter and is capable of supporting plants.

The definition includes as soil all natural bodies that contain living matter and are capable of supporting plants even though they do not have genetically differentiated parts. A fresh deposit of alluvium or earthy constructed fill is soil if it can support plants.

To be soil, a natural body must contain living matter. This excludes former soils now buried below the effects of organisms. This is not to say that buried soils may not be characterized by reference to taxonomic classes. It merely means that they are not *now* members of the collection of natural bodies called soil; they are buried paleosols.

Not everything 'capable of supporting plants out-of-doors' is soil. Bodies of water that support floating plants, such as algae, are not soil, but the sediment below shallow water is soil if it can support bottom-rooting plants such as cattails or reeds. The above-ground parts of plants are also not soil, although they may support parasitic plants. Rock that mainly supports lichens on the surface or plants only in widely spaced cracks is also excluded.

The time transition from not-soil to soil can be illustrated by recent lava flows in warm regions under heavy and very frequent rainfall. Plants become established very quickly in such climates on the basaltic lava, even though there is very little earthy material. The plants are supported by the porous rock filled with water containing plant nutrients. Organic matter soon accumulates; but, before it does, the dominantly porous broken lava in which plant roots grow is soil.

Vocabulary

- **Carbon cycle:** Sequence of transformations whereby carbon dioxide is converted to organic forms by photosynthesis or chemosynthesis, recycled through the biosphere (with partial incorporation into sediments), and ultimately returned to its original state through respiration or combustion.
- **Cation:** Particle with positive charge; reactions between anions and cations create electrical forces.
- **Cation exchange:** Interchange between a cation in solution and another cation in the boundary layer between the solution and surface of negatively charged material such as clay or organic matter.
- **Clay:** Soil particle smaller than 0.002mm or 2µm, with high specific area mainly influencing soil colloidal properties (see also colloid) as well as stability of soil structure: high stability in both wet and dry conditions; also a soil texture class.
- **Coating:** Layer of a substance completely or partly covering a surface of soil material; coatings can comprise clay, calcite, gypsum, iron, organic material, salt, etc.
- **Clay coating/film**: Coatings of oriented clay on the surfaces of peds and mineral grains and lining pores, also called clay skins, clay flows, illuviation cutans, or argillans.

- **Clay minerals:** Clay-sized hydrous aluminium silicates having a large interlayer space that can hold significant amounts of water and other substances; they have large a surface area allowing swelling and shrinking; examples are montmorillonite or smectite and kaolinite.
- **Colloid:** Particle, which may be a molecular aggregate, with a diameter of 0.1 to 0.001µm; clay and soil organic matter are often called soil colloids because they have particle sizes that are within, or approach, colloidal dimensions.
- **Colluvial:** Pertaining to material or processes associated with transportation and/or deposition by mass movement (direct gravitational action) and local, unconcentrated runoff on slopes and/or at the base of slopes.
- **Colluvium:** Unconsolidated, unsorted colluvial material.
- **Decalcification:** Removal of calcium carbonate or calcium ions from the soil by leaching. Diagnostic horizon: see horizon.
- **Electrical conductivity (EC):** Conduction of electricity through water or a solution of soil commonly used to estimate the soluble salt content in solution, e.g. soil solution.

Lesson 3

- **Erosion:** The wearing away of the land surface by water, wind, ice, gravity or other natural or anthropogenic agents that abrade, detach and remove soil particles or rock material from one point on the earth's surface, for deposition elsewhere, including gravitational creep and so-called tillage erosion.
- **Topsoil:** Frequently designated as the Ap layer or Ap horizon. See also surface soil. (ii) Presumably, fertile soil material used to topdress roadbanks, gardens, and lawns.
- **Soil fertility:** The relative ability of a soil to supply the nutrients essential to plant growth.
- **Soil nutrients:** Elements or compounds essential as raw materials for organism growth and development.
- **Soil forming process:** The variables, usually interrelated natural agencies, that are active in and responsible for the formation of soil. The factors are usually grouped into five major categories as follows: parent material, climate, organisms, topography, and time.
- **Strip cropping**: The practice of growing crops that require different types of tillage, such as row and sod, in alternate strips along contours or across the prevailing direction of the wind

- **Stubble**: The stubble of crops or crop residues left essentially in place on the land as a surface cover before and during the preparation of the seedbed and at least partly during the growing of a succeeding crop. Synonymous with trash cover.
- **windbreak**: A planting of trees, shrubs or other vegetation usually perpendicular or nearly so to the principal wind direction to protect such things as soil, crops, homesteads and roads against the effects of winds such as wind erosion and the drifting of soil and snow.
- **Plowing**: A primary broadcast tillage operation that is performed to shatter soil with partial to complete inversion, usually to depths greater than 20 cm.
- **Terracing**: The practice of building horizontal barriers on the contour, aimed at checking surface runoff and preventing it from accelerating downslope.
- **Runoff**: The volume of water that runs off the soil surface and flows into streams during episodes of intense rainfall or during irrigation that exceeds the soils infiltrability.

Soil Erosion

Soil erosion, which is the removal of the topsoil by natural forces such as wind and water, is the most serious cause of the loss of soil fertility. Lost nutrients can be artificially replaced, but the loss of topsoil is a serious problem, which cannot be easily solved.

Erosion is particularly rapid in the absence of plant cover. In places where permanent and undisturbed plant cover exists, erosion is gradual and is about in equilibrium with soil-forming processes. Vegetative cover controls erosion by diminishing the beating force of the rain, by increasing the absorptive capacity of the soil, and by holding the soil against both water and wind.

Various agricultural practices may be used to maintain a soil cover. In one such practice, strip-cropping, two or more crops are planted in alternate strips; the crops are chosen so that the land is never all bare at the same time. Another method is to cut the crop very high, leaving a long stubble behind. In this method, stubble-cropping, a special tool is used to sow the next crop directly beneath the stubble. Still another important means of maintaining a vegetative cover is the careful regulation of grazing. If too many animals graze on a small area, the lack of food causes very close grazing. Therefore, the soil is soon left bare.

Soil erosion is caused mainly by wind in arid climates and by water, especially rain, in humid climates. Wind and water erode the soil by carrying it away; therefore, any measures which reduce their speed and force will help to conserve the soil. The force of the wind, for example, may be diminished by windbreaks consisting of rows of trees or shrubs planted at right angles to the prevailing winds. On the other hand, the erosive force of water is largely controlled by reducing the speed at which water runs off the land. On sloping land, this is achieved by plowing on the contour—that is, on lines which curve around the hills at equal elevation—and not up-and-down hill. Some slopes may require the practice of terracing, which consists of cutting a slope into a number of level areas; the resulting steplike terraces are very effective in reducing the runoff speed.

تكليف

Soil erosion, whatever its cause, gradually makes land uninhabitable. As soil loses its fertility because of erosion, people attempt to move to other, more productive land. Finally, when there is no more land available, they are forced to exist on smaller amounts of food from crops which require harder work to grow. This condition leads to malnutrition and hopelessness. It is a situation always associated with severely eroded land where large numbers of people work hard for their existence. Such a situation should not happen if all the people who use and work the land have some scientific knowledge of soil conservation and if they apply their knowledge in their farming activities.

Soil Organic Matter

Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition). Most of our productive agricultural soils have between 3 and 6% organic matter. At any given time, it consists of a range of materials from the intact original tissues of plants and animals to the substantially decomposed mixture of materials known as humus.

Organic matter is made up of different components that can be grouped into three major types:

1. Plant residues and living microbial biomass.
2. Active soil organic matter also referred to as detritus.
3. Stable soil organic matter, often referred to as humus.

The living microbial biomass includes the microorganisms responsible for decomposition (breakdown) of both plant residues and active soil organic matter or detritus. Humus is the stable fraction of the soil organic matter that is formed from decomposed plant and animal tissue. It is the final product of decomposition.

The first two types of organic matter contribute to soil fertility because the breakdown of these fractions results in the release of plant nutrients such as nitrogen, phosphorus, potassium, etc. The humus fraction has less influence on soil fertility because it is the final product of decomposition (hence the term “stable organic matter”). However, it is still important for soil fertility management because it contributes to soil structure, soil tilth, and cation exchange capacity (CEC).This is also the fraction that darkens the soil’s color.

Soil organic matter plays a vital part in enhancing soil fertility and quality, on three levels:
CHEMICAL: Soil organic matter significantly improves the soil's capacity to store and supply essential nutrients (such as nitrogen, phosphorus, potassium, calcium and magnesium), and to retain toxic elements. It allows the soil to cope with changes in soil acidity, and helps soil minerals to decompose faster.
PHYSICAL: Soil organic matter improves soil structure. This ultimately helps to control soil erosion and improves water infiltration and water holding capacity, giving plant roots and soil organisms better living conditions.
BIOLOGICAL: Soil organic matter is a primary source of carbon (C) which gives energy and nutrients to soil organisms. This supports soil functionality because it improves the activity of microorganisms in the soil and it can enhance biodiversity. Capturing carbon in the soil also lowers emissions of CO_2 to the atmosphere, and this mitigates climate change.

On the basis of organic matter content, soils are characterized as mineral or organic. Mineral soils form most of the world’s cultivated land and may contain from a trace to 30 percent organic matter. Organic soils are naturally rich in organic matter principally for climatic reasons. Although they contain more than 30 percent organic matter, it is precisely for this reason that they are not vital cropping soils.

Vocabulary

- Humus: Organic compounds in soil, exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass;
- Organic soil: A soil in which the sum of the thicknesses of layers comprising organic soil materials is generally greater than the sum of the thicknesses of mineral layers.
- Peat: Organic soil material with more than 50% of organic matter derived from plant residues with not fully destroyed structure. Peat forms in a wet soil environment or below the water table where mineralisation of organic matter comes close to zero.
- Soil structure: The combination or arrangement of primary soil particles into secondary particles.
- Infiltration: The downward entry of water into the soil.
- Water holding capacity: the ability of a certain soil texture to physically hold water against the force of gravity.

- Soil tilth: The physical condition of soil as related to its ease of tillage, fitness as a seedbed, and impedance to seedling emergence and root penetration.
- Microorganism: A form of life of microscopic size.
- **Vadose zone:** The aerated region of soil above the permanent water table.
- **Till:** unsorted glacial sediment. Glacial drift is a general term for the coarsely graded and extremely heterogeneous sediments of glacial origin.
- **Soil texture:** Numerical proportion (% by wt.) of sand, silt and clay in a soil.

Lesson 5

- Eukarya : Eukarya is **the only domain that consists of multicellular and visible organisms, like people, animals, plants and trees**.
- Archaea: Archaea are **a group of micro-organisms that are similar to, but evolutionarily distinct from bacteria**.
- Herbivores: A herbivore is **an animal that gets its energy from eating plants, and only plants**.
- Detritivores: A detritivore is **an organism that eats dead or decaying plants or animals as food**.
- Predators: Predators are **organisms that hunt and kill other organisms for food**.
- Fungivores: Fungivory or mycophagy is the process of organisms consuming fungi.
- Bacterivores: A **bacterivore** is an organism which obtains energy and nutrients primarily or entirely from the consumption of bacteria.

- Parasites: A parasite is **an organism that lives on or in a host organism and gets its food from or at the expense of its host**.
- Heterotrophs : A heterotroph is **an organism that eats other plants or animals for energy and nutrients**.
- Autotrophs: An autotroph is **an organism that can produce its own food using light, water, carbon dioxide, or other chemicals**.
- Vertebrates مهره داران
- Fauna: **Fauna** is all of the animal life present in a particular region or time.
- Moles موش کور
- Gophers

- Earthworms: کرم خاکی
- Millipedes: هزارپا
- springtails mites : کنه دم فنری
- Arthropods: بندپایان
- Nematodes : بندپایان
- Protozoans: پرتوزوآ

- Flora: **Flora** is all the plant life present in a particular region or time
- Algae
- Diatoms
- Fungi
- Bacteria
- Archaea
- Metabolic Capacity

Soil organisms

- Soil organisms are creatures that spend all or part of their lives in the soil environment. Every handful of soil is likely to contain billions of organisms, with representatives of nearly every phylum of living things .
- Based on similarities in genetic material, biologists classify all living organisms into three primary domains: Eukarya (which includes all plants, animals, and fungi), Bacteria, and Archaea. Organisms can also be grouped by what they “eat.” Some organisms subsist on living plants (herbivores), others on dead plant debris (detritivores). Some consume animals (predators), some devour fungi (fungivores) or bacteria (bacterivores), and some live off of, but do not consume, other organisms (parasites). Heterotrophs rely on organic compounds for their carbon and energy needs while autotrophs obtain their carbon mainly from carbon dioxide and their energy from photosynthesis or oxidation of various elements.

- Soil organisms range in size from the tiniest virus to vertebrates some 10,000,000 times larger. The animals (fauna) of the soil range from macrofauna (>2 mm, moles, gophers, earthworms, and millipedes) through mesofauna (0.1–2 mm, springtails mites and other arthropods) to microfauna (<0.1 mm, nematodes and single-celled protozoans). Plants (flora) include the roots of higher plants, as well as single-cell algae and diatoms. Microorganisms (too small to be seen without the aid of a microscope) belonging to the fungi, bacteria, and archaea tend to predominate in terms of numbers, mass, and metabolic capacity.

Lesson 5

- peat
- Waterlogge غرقاب مانداب
- Oxidation اکسایش اکسید شدن
- water table سطح آب زیرزمینی
- heavy metals عناصر سنگین
- Vegetation پوشش گیاهی
- Groundwater آب زیرزمینی
- sediments رسوبات
- Anaerobic بی هوازی
- lithotrophic bacteria باکتری های لیتوتروف
- Leachate شیرابه
- Reaction واکنش

Acid sulfate soils

Acid sulfate soils are naturally occurring soils, sediments or organic substrates (e.g. peat) that are formed under waterlogged conditions. These soils contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, acid sulfate soils are benign. However if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides will react with oxygen to form sulfuric acid.

Release of this sulfuric acid from the soil can in turn release iron, aluminium, and other heavy metals (particularly arsenic) within the soil. Once mobilized in this way, the acid and metals can create a variety of adverse impacts: killing vegetation, seeping into and acidifying groundwater and water bodies, killing fish and other aquatic organisms, and degrading concrete and steel structures to the point of failure.

Acid sulfate soil formation

The soils and sediments which are most prone to becoming acid sulfate soils are those which formed within the last 10,000 years, after the last major sea level rise. When the sea level rose and inundated the land, sulfate in the seawater mixed with land sediments containing iron oxides and organic matter. Under these anaerobic conditions, lithotrophic bacteria such as *Thiobacillus ferrooxidans* form iron sulfides (pyrite). Up to a point, warmer temperatures are more favourable conditions for these bacteria, creating a greater potential for formation of iron sulfides. Tropical waterlogged environments, such as mangrove swamps or estuaries, may contain higher levels of pyrite than those formed in more temperate climates.

- The pyrite is stable until it is exposed to air, at which point the pyrite oxidises and produces sulfuric acid. The impacts of acid sulfate soil leachate may persist over a long time, and/or peak seasonally (after dry periods with the first rains). In some areas of Australia, acid sulfate soils that drained 100 years ago are still releasing acid.

Chemical reaction

When drained, pyrite (FeS_2) containing soils (also called cat-clays) may become extremely acidic (pH < 4) due to the oxidation of pyrite into sulfuric acid (H_2SO_4). In its simplest form, this chemical reaction is as follows:

$$2\ FeS_2 + 9\ O_2 + 4\ H_2O \rightarrow 8\ H^+ + 4\ SO_4^{=} + 2\ Fe(OH)_3\ \text{(solid)}$$

The product $Fe(OH)_3$, iron (III) hydroxide (orange), precipitates as a solid, insoluble mineral by which the alkali component is immobilized, while the acidity remains active in the sulfuric acid. The process of acidification is accompanied by the formation of high amounts of aluminium (Al^{+++}, released from clay minerals under influence of the acidity), which are harmful to vegetation.

- Potentially acid sulfate soils (also called cat-clays) are often not cultivated or, if they are, planted with rice, so that the soil can be kept wet preventing oxidation. Subsurface drainage of these soils is normally not advisable.
- When cultivated, acid sulfate soils cannot be kept wet continuously because of climatic dry spells and shortages of irrigation water, surface drainage may help to remove the acidic and toxic chemicals (formed in the dry spells) during rainy periods. In the long run surface drainage can help to reclaim acid sulfate soils.[16] The indigenous population of Guinea Bissau has thus managed to develop the soils, but it has taken them many years of careful management and toil.

- In an article on cautious land drainage,[17] the author describes the successful application of subsurface drainage in acid sulfate soils in coastal polders of Kerala state, India.
- Also in the Sunderbans, West Bengal, India, acid sulfate soils have been taken in agricultural use.[18]
- A study in South Kalimantan, Indonesia, in a perhumid climate, has shown that the acid sulfate soils with a widely spaced subsurface drainage system have yielded promising results for the cultivation of upland rice, peanut and soybean.[19] The local population, of old, had already settled in this area and were able to produce a variety of crops (including tree fruits), using hand-dug drains running from the river into the land until reaching the back swamps. The crop yields were modest, but provided enough income to make a decent living.

- Reclaimed acid sulfate soils have a well-developed soil structure thanks to the abundance of trivalent cations (mainly Al^{+3}) which have a very strong flocculating effect; they are well permeable, but infertile due to the leaching that has occurred.
- In the second half of the 20th century, in many parts of the world, waterlogged and potentially acid sulfate soils have been drained aggressively to make them productive for agriculture. The results were disastrous.[8] The soils are unproductive, the lands look barren and the water is very clear (again, due to the flocculating effect of Al^{+3}), devoid of silt and life. The soils can be colorful, though.

- Soil pollution is caused by different kinds of pollutants and contaminants due to natural and human activities. Due to rapid industrialization and urbanization, toxic chemical pollutants such as heavy metals, petroleum hydrocarbons, pesticides, organic and inorganic compounds, dyes, and many other compounds detrimentally affect the human health and soil ecosystem. Ex situ and in situ remediation of hazardous chemicals from the soil is based on the site. Remediation has been done by various physical, chemical, thermal, and biological methods. However, remediation of soil pollutants is influenced by origin, type, soil nature, soil structure, physico-chemical properties, and the type and level of contamination of soil.

Soil Pollution

- Soil Contamination: any substance in the soil that exceeds naturally-occurring levels and poses human health risks is a soil contaminant.
- Soil pollution: Soil pollution refers to the contamination of soil with anomalous concentrations of toxic substances
- Fertilizer: natural or artificial substance containing the chemical elements that improve growth and productiveness of plants.
- Mining: the process or industry of obtaining coal or other minerals from a mine.
- Agricultural Chemicals: An agrochemical or agrichemical, a contraction of agricultural chemical, is a chemical product used in industrial agriculture. Agrichemical refers to biocides and synthetic fertilizers. It may also include hormones and other chemical growth agents.

- Disposal of waste: removing, discarding, recycling or destroying unwanted materials called waste
- Pesticides: re chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants (weeds).
- Soil Remediation: is the application of proven technologies to mitigate and manage risks from contaminated soils
- Bioremediation: is a process of detoxifying or degrading contaminants present in the soil, wastewater, or industrial sludge by biological means.
- Surfactants: are chemical compounds that decrease the surface tension or interfacial tension between two liquids or a liquid and a solid
- Phytoremediation: he use of green plants to either contain, remove or render toxic environmental contaminants harmless.
- Pollutant: Toxic or harmful substances that have adverse effect on the environment.
- Contaminants: something that makes a place or a substance no longer suitable for use.

Soil chemical pollution and remediation

- Soil contamination—also known as soil pollution—is caused by the presence of manmade chemicals in the natural soil environment. It is often caused by some form of industrial activity, agricultural chemicals or the improper disposal of waste. The most common chemicals involved in soil pollution are petroleum hydrocarbons, pesticides and lead and other heavy metals. Soil contamination can also happen as a result of underground storage tanks rupturing or the leaching of waste from landfills. Mining, fertilizer application, oil and fuel dumping and a multitude of other environmental issues can also cause pollution of the soil.

- A solution to the problem of soil contamination is soil remediation. Soil remediation is a way of purifying and revitalizing the soil. It is the process of removing contaminants in order to protect both the health of the population and the environment. In short, the goal of the process is to restore the soil to its natural, pollution-free state. However, remediation of soil pollutants is influenced by origin, type, soil nature, soil structure, physico-chemical properties, and the type and level of contamination of soil. Traditionally, there are three main soil remediation technologies: soil washing, bioremediation and thermal desorption.

- Soil washing is a process that uses surfactants and water to remove contaminants from the soil. The process involves either dissolving or suspending pollutants in the wash solution.
- Bioremediation involves the use of living microorganisms, such as bacteria and fungi, to break down organic pollutants in the soil.
- Green plants can also participate in bioremediation, in which case the process is termed **phytoremediation**. Phytoremediation is an eco-friendly approach that helps to absorb the Heavy metals in the soil by using plants and trees to remediate the soil.
- In thermal desorption, heat is used to increase the volatility of contaminants, so that they can be separated from the solid material. The contaminants are then either collected or destroyed.