

PRINCIPLES OF SOIL SCIENCE

PEDOLOGY AND SOIL SURVEY

- SOILS , SOIL GENESIS AND FORMATION
- DEFINITION OF SOIL
- Loose material covering the earth's surface and supporting the growth of plants .
- Unconsolidated or loose combination of inorganic or organic materials .
- Inorganic components- products of rocks and minerals broken down by weather, chemical action and other natural processes .
- Organic components- debris from plants and animals, decomposition of many life forms inhabiting the earth.
- A living system combining with air, water and sunlight to sustain plant life .

- DOKUCHAEV, (1879)'S REVOLUTIONARY CONCEPT : surface mineral and organic formation
- Constantly manifesting themselves as a result of the combined activity of the following agencies :
- Living and dead organisms (plants and animals),
- Parent materials, Climate and Relief .

- RICHTOFER, (1888) : loose surface formation ,
- A kind of pathological condition of the native rock .
- HILGARD, (1905) : loose and friable material ,
- Through which plants may or may not find a foothold and nourishment as well as other conditions of growth using their roots .

- SOIL SURVEY STAFF, (1975) : collection of natural bodies on the earth's surface,
- In places made by man of earthy materials ,
- Containing living matter ,
- Supporting or capable of supporting plants out-of-doors .
- CANADA SYSTEM OF SOIL CLASSIFICATION : a naturally occurring unconsolidated mineral or organic matter , at least 10 cm thick ,
- Occurring on the earth's surface ,
- Capable of supporting plant growth

- BASIC TRUTH ABOUT SOIL : (a) Composed of mineral matter , organic matter (both living and dead), water and air,
- (b) Occurs at the interface between the **LITHOSPHERE**, the **HYDROSPHERE**, the **BIOSPHERE** and the **ATMOSPHERE** ,
- The soil ecosystem contains components of all these **SPHERES** (IITA) .

SOIL GENESIS AND FORMATION

- Buol et al (1980): **Soil Genesis or Pedology** is the phase of soil science that deals with the factors and processes of soil formation,
- Includes description and interpretation of soil profiles, soil bodies and patterns of soil on the surface of the earth.
- Main repository of the concept of soil .
- **SOIL PHYSICS** is the study of soil physical properties and processes.

The Classical Simonson's 'Outline of a generalized theory of Soil Science (Simonson, 1959)

- Soil genesis consists of two steps :
- (a) The accumulation of parent materials,
- (b) The differentiation of horizons in the profile .
- He placed emphasis on the operations of soil forming processes in combination, with some processes promoting and others offsetting or retarding horizon differentiation .

- Kubiiena's principle of micropedology, i.e. The principles of undisturbedness and functional investigation, in part by direct observation of function aptly summarized the concept of soil as a living entity (Kubiiena, 1964) .
- Simply put, Pedology is the study of different soil types and their properties .

- Soil genesis helps farmers to select and support the crops on their land ,
- Helps farmers to maintain fertile, healthy ground for planting .
- Also helps in engineering and construction .
- Soil takes a long time to develop- thousands or even millions of years.
- Soil is effectively a nonrenewable resource .

FACTORS AND PROCESSES OF SOIL FORMATION

- Soil formation is an ongoing process through the combined effects of five soil forming factors:(a) Parent material,(b) Climate, (c) Living organisms:(d) Topography, and (e) Time.
- Each combination of the five factors produces a unique type of soil that can be identified by its characteristic layers called horizons.
- Soil formation is also known as pedogenesis (from the Greek word 'pedon' for ground and 'genesis' meaning birth or origin .

- PARENT MATERIAL :
- The first step in pedogenesis is the formation of parent material from which the soil itself forms .
- About 99% of the world's soils derive from mineral-based parent material that are the result of weathering- the physical disintegration and chemical decomposition of exposed bedrock .
- The remaining % derives from organic parent material- the product of environments where organic matter accumulates faster than it decomposes, i.e. in marshes, bogs and wetlands.

- Bedrock itself does not give rise to soil.
- Gradual weathering of bedrock produces REGOLITH a layer of loose rock debris or mantle ,
- Further weathering of this debris leading to increasingly smaller and finer particles ultimately results in the creation of soil .

- CLIMATE :
- Water, Ice, Wind, Heat and Cold are elements of climate causing physical weathering by loosening and breaking up of rocks .
- Climate also determines the speed or rate of chemical weathering .
- Climate also influences the developing soil by determining the types of plant growth that occur, i.e. low rainfall discourage the growth of trees but encourage the growth of grass .

- LIVING ORGANISMS :
- As parent material accumulates, living things begin to grow marking the formation of true soil. Mosses, lichens and other lower plants appear first .
- As they die, the remains add humus to the soil for the growth of higher plants .
- Plants trap dust from volcanoes and deserts.
- Growing roots break up rocks .
- Animals mix soils by tunneling in them .

- TOPOGRAPHY or RELIEF :
- Degree of slope on which a soil forms helps to determine how much rainfall will run off the surface and how much will be retained.
- TIME :
- Soil formation time varies according to the action of the other soil forming factors. Young soils may develop a few days from alluvium or from volcanic ash eruptions. Other soils may take thousands or millions of years to form .

HORIZONS

- As soils develop, they are arranged in a series of layers known as horizons starting at the surface and proceeding deeper into the ground reflecting different properties and different degrees of weathering .
- A typical soil profile has the surface horizon as the O layer consisting of loose OM such as fallen leaves and other organic biomass.
- Below this is the A horizon containing a mixture of inorganic mineral materials and OM .

- Next is the B horizon in which iron, clays and other mineral materials have accumulated .
- Under this layer is the C horizon consisting of partially weathered rock .
- Lastly, is the R horizon of hard bedrock .
- Each horizon may have many subordinate names to describe the transitional areas between the main horizons .

HISTORY OF SOIL SCIENCE

- Began from the contributions of chemist Justus von Liebig, and others like Dokuchaev, Marbut, Hans Jenny and Guy Smith .
- Liebig, a German chemist, (1803-1873) worked on soil samples in laboratories, greenhouses and on small field plots .
- Soils rarely examined below the depth of normal tillage .
- These chemists held the 'balance sheet' theory of plant nutrition-storage bin for plant nutrients, i.e. soils could be used and replaced .

- Early geologists also held this view, and considered soils as products of geologic formations .Many of the early workers were geologists. This theory was taught until the late 1920s .
- Scientific basis of soil science as a natural science was established by the classical works of Dokuchaev , who considers soil as a natural body having its own genesis and its own history of development.

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- Thus, the Russian school of soil science under the leadership of Dokuchaev (1846-1903) , developed this new concept of soil .
 - This concept made possible a science of soil.
 - This Russian concept was thus broadened and adapted for use in the USA , and gradually throughout the whole world .

