RAMA UNIVERSITY

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FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES

INTRODUCTION

Soils have great meaning for human kind. From the dawn of agriculture, cultivators recognized good soils being attracted to the fertile soils of river valleys. Most great civilizations have depended on good soils. Continuous replenishment of fertility by natural flooding made possible the stable, organized communities and even cities, in contrast to the nomadic, shifting societies. Mismanagement of fertile soils is the only contributing factor for the down fall of the society. The careful preservation of the soil mantle can be the difference between a prosperous society and poverty. History provides lessons that modern nations have not always heeded.

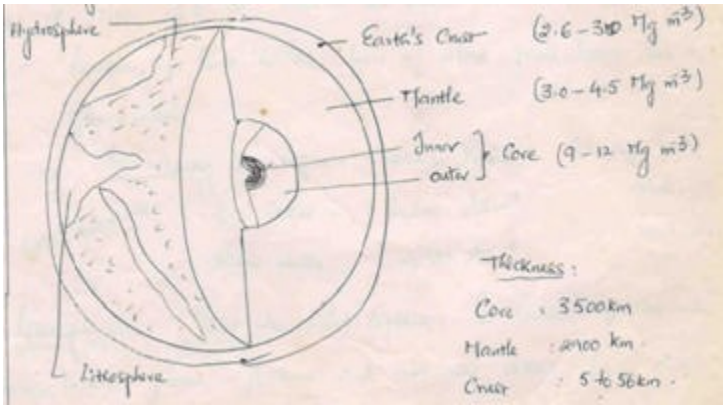
The soil serves not only as a medium for plant growth and for microbiological activity *per se* but also as a sink and recycling factory for numerous waste products which might otherwise accumulate to poison our environment. Moreover, the soil supports our buildings and provides material for the construction of earthen structures such as dams and road beds.

In many regions, we find once- thriving agricultural fields reduced to desolation by man-induced erosion or salinization resulting from injudicious management of the soil-water system. Add to that , the shortsighted depletion of non -replenished water resources as well as the dumping of poisonous wastes is indeed a consistent pattern of mismanagement. Despite the known degradation of resource, we still continue squandering and abusing such precious resource, for the sake of population-environment -food crisis being faced by the world.

Spheres of Earth

Geographically EARTH constitutes of three spheres corresponding to three states of matter (Solid, Liquid & Gas)

The solid zone is Lithosphere. The incomplete covering of water forming seas and oceans (liquid spheres) is Hydrosphere. The gaseous envelop over the earth surface is Atmosphere.



Atmosphere:- The atmosphere forms an envelope, 322 Km over the earth's surface. This envelops of air that covers both lithosphere and hydrosphere is called atmosphere. It contains water modules and dust, which act as nuclei for the condensation of water vapour to form cloud or fog.

N_2	-	78.054 %	O_2	-	20.946 %
CO_2	-	0.033 %	Argon	-	0.934 %

In addition, inert gases such as helium, neon, krypton and xenon are present. The water vapor content in atmosphere varies from place to place and time to time. Air becomes less dense with height until it gets too thin to support life. Atmosphere contributes only 0.03 % weight to the earth.

Hydrosphere

1 Covers almost $3/4^{th}$ of earth crust.

2 The Hydrosphere is 10 Km deep and occupies 70 % of earth's surface.

3 Hydrosphere makes only 6.91 % of the earth mass but by volume 15 times than that of the visible land above the sea level.

4 It contains absorbed air and carries particles of rocks as sediments.

5 Most of it lies within the ocean basins and also appears on surface of land in the form of rivers, ponds, lakes and as ground waters.

6 The quality of different waters, varies

Lithosphere

It is the solid sphere. It consists of continents, ocean basins, plains, plateaus and mountains, valleys, sand dunes, lava flows and fault scraps. The interior of earth consists of rocks and minerals. It is covered by gaseous and watery envelops. It amounts to 93.06 % of earth's mass.

Composition of Earth's Crust

Most of the hard, naturally formed substance of the earth is referred to as 'rock' out of 106 elements known eight are sufficiently abundant as to constitute 98.6 % (by weight) of the earth crust (up to 16m)

Out of eight elements, two are in great abundance and comprise ¾ the total composition of the crust. The other six elements are metals.

Non metallic (%)	O^{2-} - 46.60	Titanium - 0.41	
	Si^{4+} - 27.72	Hydrogen – 0.17	
	Carbon - 0.12		
Metallic	- Al^{3+} – 8.13	Phosphorus- 0.09	
	Fe^{2+} – 5.00	Sulphur - 0.07	
	Ca^{2+} - 3.63	Manganese- 0.07	
	Na^{+} – 2.83	Barium - 0.05	
	K^{+} – 2.59	Strontium - 0.02	Mg^{2+} – 2.09

Chromium, Nickel, Lithium chlorine & Fluorine – each 0.01 Ot**he**rs – 1.41

"Without life, there is no soil and without soil, there is no life on the earth planet"

"Soil is the interface of the organic and inorganic chemistry of the terrestrial world, combining nitrogen and carbon from the atmosphere with the various elements of mineral lithosphere via the organisms anchored in the soil, intercepting energy of the sun and moisture from the hydrosphere and atmosphere."

The word **"Soil"** is derived from Latin word **'Solum'** means **'Floor' or 'Ground' SOIL COMPONENTS**

Mineral soil consists of four major components i.e., inorganic or mineral materials, organic matter, water and air. In a representative loam surface soil, the solid mineral particles comprise about 45% of the soil volume and organic matter 5%. At optimum moisture for plant growth, the pore space is divided roughly in half, 25 %, of volume being water space and 25 % air. The proportions of air and water are subjected to rapid and great fluctuations.

The four soil components occur in a thoroughly mixed condition in soil and this mixture encourages interactions within and between the groups and permits marked variations in the environment for the growth of plants.

The proportion of different components in the diagram depicts the good soil condition for plant growth (Loam surface soil).The air and water are extremely variable and their proportions determine in large degree the soil's suitability for the plant growth.

Mineral Matter: The Inorganic portion of soils is quite variable in size and composition. It is composed of small rock fragments and minerals of various kinds. *Rock Fragments*

2.0	-	75.0 mm	-	gravel or pebbles
75.0	-	250.0 mm	-	cobbles (round) flags (flat)
	>	250.0 mm	-	stones or boulders

Soil Particles

.2		2.0mm	- sand (gritty)
.02		0.2mm	- fine sand (gritty)
.002		0.02 mm	- silt (powdery)
		0.002 mm	- clay (sticky)

The proportion of different sized particles (texture) determines the nutrient supplying power of the soil, considerably. Primary minerals (original) are prominent in sand and slit fractions; where as the secondary minerals (formed) dominate in cla y fraction and in some cases the silt fraction. The inorganic fraction of soil is the original source of most of the mineral elements that are essential for plant growth.

Organic Matter

It comprises an accumulation of partially disintegrated and decompose d plant and animal

residues and other organic compounds synthesized by soil microbes as the decay occurs. It is a transitory soil constituent as it is continuously broken down by soil organisms and lasts from few hours to several hundred years. It requires maintenance by regular addition to the soil of plant and/ or animal residues .Organic matter content varies from 1.0 to 6.0 % by weight in top soil and very less in sub soil. In respect of soil productivity organic matter plays an indispensable role.

Soil Water

Soil water is held in soil pores with varying degrees of tenacity depending on the amount of water present and size of the pores. Soil water with its soluble constituents (nutrients) makes up soil solution, which is the critical medium for supplyin g nutrients to growing plants. Soil water plays significant role in controlling energy balance of the soil and regulates the gaseous exchange in the upper layer of the soil.

The presence of water in different amounts in soil governs its thermal, mechanica l, physical, chemical and biological properties.

Soil Air

The content and composition of soil air are determined largely by the water content of the soil, since the air occupies those soil pores not filled with water.

Soil air always differs from atmosphere air in composition because of moisture content, root and microbial activities.

1. Relative humidity may approach 100% at optimum soil moisture
2. CO_2 content is often several hundred times higher than 0.03 3
3. Oxygen content usually <20%. In extreme cases only 5

Definition of Soil

“Soil is a natural body composed of inorganic and organic const ituents, having a definite genesis and a distinct nature of its own” -- **Dokuchaev (1900)**

“Soil is a natural occurring body that has been evolved owing to combined influence of climate and other organisms, acting on parent material, as conditioned by relief over a period of time” --**Jenny (1941)**

"Soil is the unconsolidated mineral matter on the immediate surface of the earth that serves as a natural medium for the growth of land plants"

"Soil is the unconsolidated mineral matter on the surface of the earth t hat has been subjected to and influenced by genetic and environmental factors of parent material, climate, macro and micro organisms and topography, all acting over a period of time and producing a product, that is soil, that differs from the material from which it is derived in many physical, chemical, biological and morphological properties and characteristics -- **SSSA (1970)**

"Soil is a natural body synthesized in a profile form from a variable mixture of broken and weathered minerals and decaying organic matter, which covers the earth in a thin layer and which supplies, when containing proper amounts of air and water, mechanical support and in part sustenance to plants"

Modern Concepts of Soil

Knowledge about soils comes from two basic sources; farmer experience based on centuries of trial and error, and scientific investigations of soils and their management

1 From the dawn of agriculture, cultivators recognized good soils being attracted to fertile soils of river valleys.

2 More than 42 centuries ago, Chinese used a schematic soil map as a basis for taxation.

3 Homer (about 1000 B.C.) referred the use of manure on the land.

4 Early Greek and Roman writers described farming systems that involved leguminous plants and the use of ashes and sulphur as soil supplements.

Early Scientific Investigations

French agriculturist **J.B. Boussingault** (1834) proved that air and water were the primary sources of C, H, and O in plant tissue.

German chemist – **Justus Von Leibig** (1840) - Crop yields were increased by adding minerals or inorganic elements to the soil. He proposed that the mineral elements in soil and in added manures and fertilizers are essential for plant growth. He disproved the

humus theory.

Leibig's research led to the concept that certain factors were essential for plant growth and that if any one of these factors was limiting, plant production would be reduced accordingly – **Law of Minimum**

R. Warrington – Nitrogen transformations are biological

S. Winogradski (1890) – Isolated two groups of bacteria responsible for nit rogen transformations.Nitrogen assimilating bacteria grow in nodules of leguminous plants

Research in USA

C G Hopkins (Illinois): Developed effective soil management system based on lime stone, rock phosphate and legumes.

Milton Whitney of USDA emphasized field studies and initiated the first National Soil Survey Systems.

F H King(Wisconsin) studied the movement and storage of water in soils in relation to root penetration and crop growth.

Branches of Soil Science

Pedology:- The Science dealing with the genesis ,survey and classification and the laws of geographical distribution of soils as a body in nature. Pedology is the study of soil as a natural body and does not focus primarily on the soil's immediate practical use.

Edaphology:- The science that deals with the influence of soils on living things, particularly plants, including man's use of land for plant growth. Edaphology is the study of soil from the stand point of higher plants.

Soil Fertility: - The quality of the soil that enables it to provide essential chemical elements in quantities and proportions for the growth of specified plants

Soil Chemistry:- Deals with the chemical constituents , the chemical properties and the chemical reactions of soil in relation to crop needs.

Soil Physics:- Study of various physical processes that are taking place in and through the soils .

Soil Microbiology:- Deals with microscopic population of the soil, its role in various transformations and its importance in plant nutrition and crop production.

Soil Conservation:- Deals with the protection of soil against physical loss by erosion and against chemical deterioration.

Soil Genesis:- The study of t he mode of origin of soils, with special reference to the processes responsible for the development of Solum or true soil from the unconsolidated parent material.

Soil Survey:- The systematic examination, description, classification and mapping of soils in an area.