Organic Matter And Flora-Fauna: A Geographical Study

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Abstract

The living organisms (plants and animals) and organic matter together constitute 5 to 12% of the total composition of soil system. The organisms living in the ground or soils are called edaphons. It is very difficult task to differentiate the organisms living in the soil and in the ground from those organisms which live on the ground because most of the major groups of organisms are common to both the environment (soil environment and ground surface environment). The animals living in the soils vary in size from 20 cm in length to less than 20 micrometers. The soil animals are classified into three groups viz. (i) macro-fauna, (ii) meso-fauna, (iii) micro-faun.

Since man-induced soil erosion has resulted into the loss of fertile soils and thus degradation of agricultural lands and rill and gully erosion augmented by extensive use of natural resources has rendered millions of hectares of land into wasteland. Sincere efforts are immediately required to halt accelerated rate of soil erosion caused by rill and gully erosion and to protect the cultivated farms from slow poisoning through rain splash and sheet erosion. Any viable soil conservation measure includes some basic objectives e.g. (i) protection of surface from raindrop impact, (ii) increase in the infiltration of rainwater, (iii) decrease in the volume and velocity of overland flow, and (iv) reduction in the erodibility of soils or increase in the resistance of soil against erosion by modifying physical and chemical properties of soils.

Flora –fauna the mechanics and forms of soil erosion are divided into two major categories e.g. (i) slow rate of soil erosion mainly through rain splash, rainwash and sheetwash, which are operative to greater extent in the cultivated areas, cut-over land and abandoned agricultural land and (ii) accelerated rate of soil erosion through rill and gully erosion which is operative over the hill slopes cleared of vegetation covers sloppy grounds and riparian zones of the rivers, separate soil conservation measures and techniques are required to check soil erosion of the aforesaid two categories.

Reference to this paper should be made as follows:

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Introduction

The composition of soils is generally studied through its vertical sections which are termed as soil profiles and these extend from the ground surface down to the unweathered parent rocks. If the whole length of vertical section right from the uppermost stratum of the plant community down to the basal weathering surface or the upper surface of unweathered parent rocks is taken into account, two major zones are identified e.g. (i) vegetation zone, (ii) soil zone.

There are four major components of soil system which need consideration for understanding the composition and characteristics of soil in a given area e.g. (i) flora, fauna and organic matter, (ii) inorganic minerals, (iii) soil solution, (iv) soil atmosphere.

The vegetation zone consists of four strata viz. (i) tree stratum (ii) bush stratum, (iii) field stratum (grasses, herbs, flowering plants and agricultural plants) and (iv) ground stratum (mosses, lichens and other plants which thrive on the ground surface). The soil zone consists of two layers or sub-zones viz. (i) the solum which contains loose unconsolidated weathered materials, organic matter and living organisms. (ii) Sub-soil zone which contains inorganic matter and uninhabited weathered rocks known as regolith. Sometimes the whole zone of loose and unconsolidated weathered rock materials whether containing living organisms or not is called regolith.

Organic Matter and Flora-fauna

The soil is in fact the very heart of life layer known as biosphere because it represents a zone wherein plant nutrients are produced, held, maintain and are made available to plants through their roots through the process of root osmosis; and to micro-organisms which live in the soils. The geographical study of soil zone is considered a significant ecological factor and hence a great biological factor because of the following reasons:

- The soil layer functions as a medium for the transfer paths of energy and matter and helps in the biological cycling of nutrients.
- Great varieties of organic compounds are generated in the soil layers.
- The soil layer provides habitats and ideal environmental conditions for living organisms of several varieties and numerous species.
- This is the soil layer where organic matter derived from the plants and animals and minerals derived from the parent rocks are disintegrated and decomposed and are changed into elements.
- Necessary nutrients are made available to plants from the soil layer.

- Soil layer holds water in storage which is used by plants and animals which live in the soils.
- Soil is basic medium for food and timber production to human society.

It is very important natural exhaustible resource because it cannot be replaced if it is destroyed or lost through soil erosion caused by anthropogenic activities.

The soil system is the product of environmental and biological processes and is interrelated with climate vegetation (flora) animals (fauna), underlying rocks, topography and time which also affect the biosphere. The comprehensive study of soil system in terms of is components, its classification, processes of its formation and its evolution through time is of vital significance because it is an integral part of the biographic system.

Table 1

Soil Components

S.No.	Major components	Percentage composition
1.	Living organisms and organic matter	2 – 14%
2.	Mineral matter	35 – 50%
3.	Soil solution	10 – 45%
4.	Soil atmosphere	12 – 35%

Macro-animals living in the soils and organic matter are over one centimeter in length and these include both vertebrates and invertebrates of chordate phylum. The important species of chordate vertebrates are mammals.

Meso-animals of the soil environment are of the size ranging between one centimeter and 0.2 mm in length and these include smaller mites and majority of spiders.

Micro-animals include the smallest organisms that live in the soil environment. The length of their body is usually less than 0.2 mm.

A few aspects of fauna like

(i) The length of time-spent by the fauna in the soils.
(ii) Their feeding habits
(iii) Their habitats
(iv) Their movements

The soil fauna are divided into three groups on the basis of length of time spent by them e.g.

(i) Those soil animals which enter the soil environment when they become adult to take refuge during hibernation.
(ii) Those soil insects which spend their early life in the soils as eggs or

larvae (like butterflies, moths etc.)

(iii) Those which spend almost whole of their lives (many invertebrate insects).

The soil fauna are divided into five categories on the basis of feeding habits viz. (i) carnivores, (ii) phytophages (those fauna which feed on either plants standing above the ground or on roots of plants or on woody plant materials. (iii) Saprophages (those soil animals which feed on dead and decomposed organic matter), (iv) microphytic feeders, which feed on spores, lichens, fungi, algae and bacteria (like mites, nematodes etc.), (v) composite animals which feed on a variety of materials.

From the standpoint of habitats soil animals are divided into three groups which are associated with three sub-layers or horizons of organic layer e.g. (i) soil fauna of letter horizons (or/horizon or layer of fresh litter), (ii) soil fauna of fermentation horizons layer or horizon of well decomposed litter), (iii) soil fauna of humus horizons (layer or horizon of well decomposed litter and sometimes mixed with mineral matter).

Soil flora and micro-organisms

Soil flora and micro-organisms include larger plants mainly their roots, fungi, bacteria, algae and soils protozoa. These organisms largely affect properties of soils of a given region. The bacteria and fungi are basically microbes which play very crucial role in the transfer and circulation of nutrients and flow of energy in the ecosystems. The fungi are the chemosynthetic organisms representing various groups of soil organisms which perform a verity of duties in the soil zone viz. formation of mycorrhizas; breaking down of organic matter, attack on living organisms and introduction of several plant diseases. A few of the fungi are important commercial sources of antibiotic medicines and enzymes. Bacteria are the most important microbes of the soil zone because they play significant roles in (i) decaying wood and vegetation, (ii) decomposing organic matter, (iii) producing humus, (iv) cycling of nutrients.

Algae are photosynthetic organisms and live in the upper surface of the soil horizons. They are very important to the soils because they (i) supplement the soil minerals with organic matter, (ii) play a cohesive role in binding the soil particles together, (iii) make the soil structure stable which protects the soil from excessive leaching and erosion, (iv) provide nutrients for higher plants, (v) help in the aeration of poorly drained soils, (vi) help in fixing the atmospheric nitrogen etc.

The soil atmosphere component of the soil system includes the consideration of the presence of different gases and air, the movement of air within the soils and temperature distribution. It is important to note that there is variation in the proportion

of oxygen and carbon dioxide of the aboveground atmosphere and the soil atmosphere as is evident from,

Table 2

Composition of the soil and aboveground atmosphere (in percent by volume)

Composition	Oxygen	Carbon Dioxide	Nitrogen	Water Vapour
Above-ground Atmosphere	20197	D103	78.00	< 100
Grassland Soil	18130	1160	79.2	--------
Arable Soil	21.60	0.10	79.2	Frequently 100

The concentration of c02 in the soil atmosphere is several times higher than the natural concentration of c02 in the above ground atmosphere. This difference of carbon-dioxide between the soil atmosphere and the above-ground atmosphere is because of the fact that there is continuous evolution of carbon-dioxide due to decomposition of organic-matter by the microscopic of organisms in the soils. On the other hand oxygen is consumed by the plants through respiration and thus there is gradual depletation of soil oxygen (02) with the increase of soil organisms. The ratio-between c02 production and 02 consumptiondepends on a variety of factors e.g. the amount of moisture in the soil temperature the rate of decomposition of organisms and plant roots in the rhizosphere or rootsphere between the amount of soil water and soil air. If there is minimum amount of water in the soils (wilting stage), there is maximum air in the soil (the stage of well aerated soil or aerobic stage of soil) contrary to thus if there is maximum amount of water in the soil (saturated stage) there is minimum air in the soil (the stag of poorly aerated soil or anaerobic stage of soil environment). Thus the CO_2: O_2 ratio in the aerobic soil is around because plants consume maximum amount of oxygen but the CO_2 : O_2ratio becomes more than in the anaerobic soil becomes due to excess water plants are unable to consume required

Besides oxygen, a few more gases are evolved due to decomposition of organic matter by the decomposers e.g. methane, ethylene salphides etc. it is evident that the water-air ratio in the soils is very crucial factor for the survival and growth of soil s organisms particular plants because abundant oxygen is required by the plant roots for the oxygen is required by the plant roots for the proper growth of vegetation. If the soli continue to be wet and over-saturated for longer period the amount of the air present in the soils become minimum and therefore the respiration by plants is retarded, with the results reveal plants die.

Soils differ on account of differences in physical morphological, chemical and biotic characteristics and composition which are the prime factors for stimulating the efficiency for growing plants. These characteristics very in different soil horizons because of changing complex of minerals and organic constituents. However, the impact of parent material, topography and atmospheric conditions and the genetic classification of soil have been analysed elsewhere yet the study of chemical composition of soils, and their fertility have to be looked into for better growth of plants, successful cropping system and proper land use intensity.

- Soils of good fertility
- Soils of medium fertility
- Soils of poor fertility
- Soils of very poor fertility

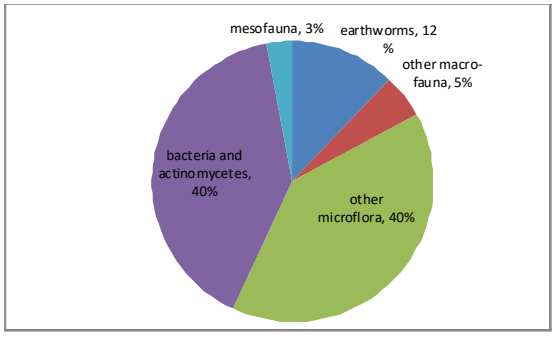
The high medium and low nutrients present the following numerical categories:

Nutrients	High	Medium	Low
Nitrogen (N_2)	Above 500	500 – 250	250 below
Phosphorus (P_2O_5)	Above 60	60-20	20 below
Potassium (K_2O)	Above 350	360-150	150 below

Hydrogen pH value 7.5 = alkaline 7.5, 6.5 = normal and 6.5 below = acidic

Conclusion

Organic matter and flora fauna includes dead and decomposed parts of living plants and animals. In other words, organic matter represents the non-living biomass of plants and animals. The varied function of organic matter are very important to soil zone and the organisms of the biospheric ecosystem as it (i) provides nutrients to plants, (ii) is a major source of energy for majority of the soil organisms; (iii) helps in the formation of soils, (iv) is enriched by continuous input of matter from plants and animals. (v) undergoes continuous process of its breakdown and decomposition, (vi) is constantly circulated, cycled and recycled.



The organic matter of the soil zone is comprised of (i) 85% of dead organic matter together with products of decomposition, (ii) 10% of plant roots and 5% of edaphons.

The quality and quantity of water present in the soil zones affect the flora-fauna of the soil zones and the organisms mainly plants above the ground but having their roots in the soils. The presence of water in the soils in must because it helps in the preparation of soil solution containing nutrients which are taken up by the plants through their roots through the process of root osmosis. The amount of water held by the soils is determined by the rate of infiltration of rainwater and meltwater and the water retention capacity of soils.

On an average there are three rates of infiltration viz. (i) low rate (0.25 cm of water percolating downward per hour), (ii) moderate rate (1.27 t 2.54 cm per hour), (iii) high rate (more than 2.54 cm per hour).

The clay soils, loam soils and sandy soils account for low, moderate and high rate of infiltration respectively. On the basis of amounts of water retained in the soils with respect to soil volume three stages of the proportions of solid matter, water and air can be identified e.g. saturated stage when all the voids and pores within the soils are filled with water.

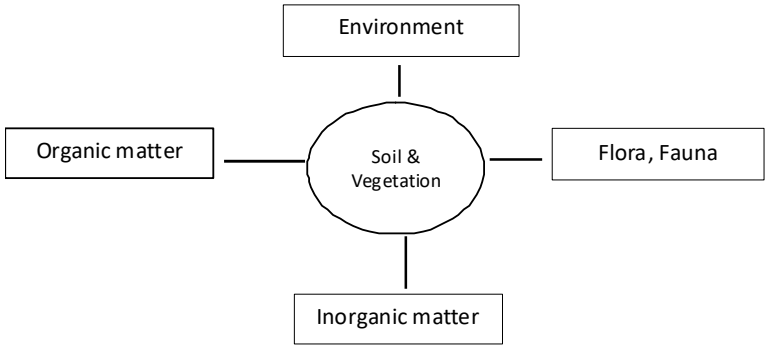
The saturated stage of the soil water is not useful for the organisms because it causes respiratory problem to soil organisms, damages root system of plants, causes death to microflora and fauna. Similarly, wilting stage of the soil water causes death of soil organisms. Thus the water held between field capacity and wilting stage is most suited to soil organisms.

The organic factors which influence the formation of the soils include flora, fauna and micro-organisms. Various characteristics of plants viz., leaf fall, canopy, stem flow (flow of rainwater through the stems of plants), root system, competitiveness etc. influence and modify the characteristics of the soils of a region. The nature of tree canopy affects the soil moisture and soil temperature. The chemical composition of leaf litter largely determines the chemical properties of the soils.

The roots also help in the binding of soil particles together and thus assist in the formation of soil aggregates (peds). The plants provide organic matter to the soils.

Flora-fauna play a major role in influencing the major soil forming processes e.g. transformations and translocations. The macro and meso-fauna affect and modify the soil properties through burrowing transporting and mixing of organic and inorganic materials. Rabbits, males, prairie dogs, ground squirrels, beavers, rats etc. are amongst

the largest modifiers of the soils. Among the mesofauna which modify the soils important are earthworms, mites, springtaits, termites etc. Micro-organisms decompose the organic matter.



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