SOIL HEALTH AND ENVIRONMENT: POTENTIAL BENEFITS OF SOIL ORGANIC CARBON

Siddu Malakannavar[1], Iyarin Thanka Mahil E[2] and Divyashree, K. S.[3]

[1]Research Associate, Department of Soil Science and Agril. Chemistry, UAS, GKVK, Bengaluru

[2]Assistant Professor, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu

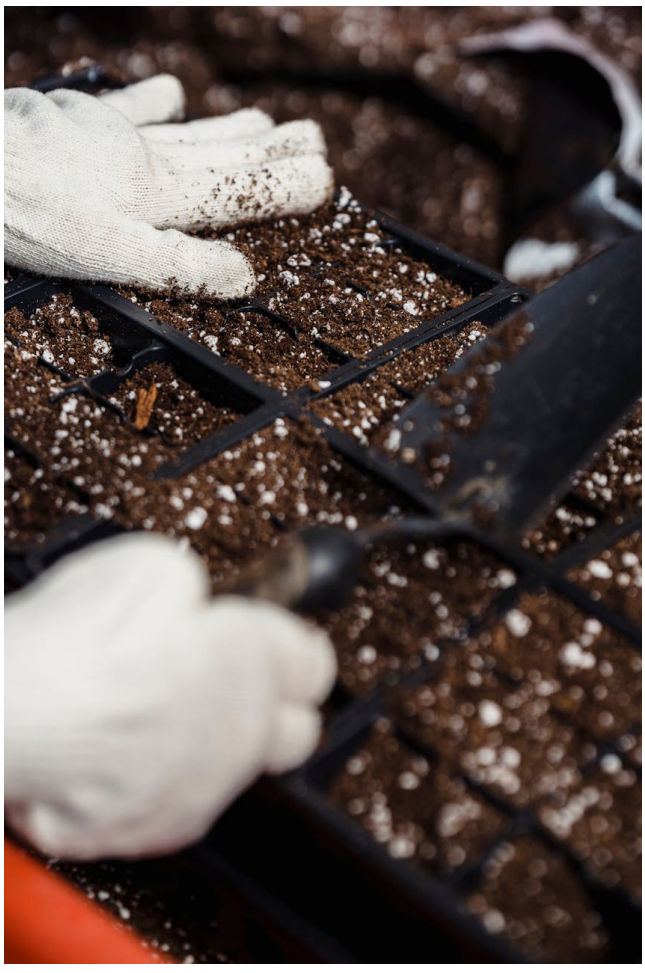
[3]Research Associate, Centre of Excellence, REWARD, UAS, GKVK, Bengaluru

INTRODUCTION

The myriad organisms inhabiting soil engage in intricate interactions, contributing to essential cycles such as carbon, nitrogen and phosphorus, that sustain all life on earth. Soil plays a crucial role in purifying water, since minerals and microbes in the soil filter and buffer potential pollutants, some of which are absorbed by soil particles. This filtration process is facilitated by a diverse array of organisms, including earthworms, ants and termites, which create channels for water and air flow. Moreover, soil regulates water movement, preventing floods by determining whether rainfall, snowfall, or irrigation water will flow over or through the land. Healthy soil characterized by high biodiversity, serves as a defense against pests and fosters the growth of plants. In addition to providing physical stability for plants by anchoring roots, soil contributes to the creation of oxygen and clean water, benefiting all life on earth. It also offers support to manmade structures, including delicate archaeological sites. Finally, soil plays a crucial role in climate change mitigation, serving as the second-largest carbon sink after the ocean. It continually stores and releases carbon, regulating atmospheric CO2 concentrations and influencing the greenhouse effect.

SOIL HEALTH AND ENVIRONMENT

The myriad organisms inhabiting soil engage in intricate interactions, contributing to essential cycles such as carbon, nitrogen and phosphorus, that sustain all life on earth. Soil plays a crucial role in purifying water, since minerals and microbes in the soil filter and buffer potential pollutants, some of which are absorbed by soil particles. This filtration process is facilitated by a diverse array of organisms, including earthworms, ants and termites, which create channels for water and air flow. Moreover, soil regulates water movement, preventing floods by determining whether rainfall, snowfall, or irrigation water will flow over or through the land. Healthy soil characterized by high biodiversity, serves as a defense against pests and fosters the growth of plants. In addition to providing physical stability for plants by anchoring roots, soil contributes to the creation of oxygen and clean water, benefiting all life on earth. It also offers support to manmade structures, including delicate archaeological sites. Finally, soil plays a crucial role in climate change mitigation, serving as the second-largest carbon sink after the ocean. It continually stores and releases carbon, regulating atmospheric CO2 concentrations and influencing the greenhouse effect.



THE TOP 10 THREATS TO SOIL HEALTH, AS NAMED BY THE FAO

1. **Soil Erosion:** The loss of valuable topsoil mainly through water, wind, tillage, or other means. Topsoil is the most fertile layer and contains the higher amount of organic matter. It supports the growth of plants, which in turn provide habitat and food for other organisms. When topsoil is eroded, the soil becomes less fertile and less able to support plant growth, which can lead to the decline of ecosystems and decreases the agricultural productivity.

2. **Soil Organic Carbon Loss:** Organic carbon is an essential component of soil, contributing to soil fertility, water-holding capacity, and overall soil health. Soil organic carbon is derived from plant and animal residues, which are decomposed by soil organisms into organic matter.

3. **Soil Nutrient Imbalance:** It refers to an unequal distribution of essential nutrients in the soil, which can negatively impact on plant growth and overall soil health. Essential plant nutrients, such as nitrogen, phosphorus and potassium, are required in specific proportions to support healthy plant growth. When these nutrients are not in balance, it can lead to a variety of issues

4. **Soil Salinization:** Soil salinization causes soil to get more and more salted which leads to decline in soil fertility and productivity. It alters the physical, chemical, and biological properties of soil. In addition, salt accumulation at higher concentration is toxic to plants.

5. **Soil Contamination:** Harmful substances introduced into the soil can harm the plants, animals, and humans. Soil contamination can occur due to various sources, including: Agricultural practices - the use of pesticides, fertilizers, and other chemicals dumping for improved crop production; Industrial activities - mining, manufacturing, and waste disposal; Natural sources - volcanic eruptions or leaching of minerals from rocks.

6. **Soil Acidification:** Process by which soil pH decreases, becoming more acidic. Soil acidification can occur naturally over time, but it can also be accelerated by human activities, such as the use of acidifying fertilizers, land use change, and soil degradation.

7. **Loss of Soil Biodiversity:** Loss of soil biodiversity can have a significant impact on soil health, as the health of soil ecosystems is closely tied to the diversity of soil biota, such as microorganisms, insects, and plants.

8. **Soil Sealing:** refers to the process by which the natural properties of the soil are altered through the application of a hard and impermeable surface layer, such as concrete, asphalt, or brick. This layer acts as a barrier, reducing the exchange of air, water and nutrients between the soil and the atmosphere, and preventing the natural infiltration of water into the soil.

is a bad thing for soil health because it reduces the porosity and pore space of the soil, making it more difficult for roots to penetrate the soil and access essential water and nutrients.

10. **Water logging:** Situation where the soil remains waterlogged, or flooded, for an extended period of time. It occurs when the rate of water entering the soil exceeds the rate at which water can drain out of the soil. This can lead to saturation of the soil and a buildup of water in the root zone, reducing the availability of oxygen to the roots of plants and creating a stressful environment for plants to grow in.

INDIA'S SOIL BIODIVERSITY IS IN GRAVE PERIL

The WWF's 'risk index' for the globe — indicating threats from loss of above-ground diversity, pollution and nutrient over-loading, over-grazing, intensive agriculture, fire, soil erosion, desertification and climate change — shows India among countries whose soil biodiversity faces the highest level of risk.

The main soil qualities that are considered as Soil health indicators are nutrient availability, workability, oxygen availability to roots, nutrient retention capacity, toxicity, salinity and rooting conditions. It is easy to mistake soil for an inert, lifeless substance like the rock that so often lies beneath. Over a billion individual microorganisms can inhabit a single gram of soil. This abundance of life is made up of a diverse assemblage of bacteria, fungi and a cohort of microscopic animals, insects and worms. Most soils are inhabited by over a thousand different types (or species) of organisms, all of which play a part in determining how the soil functions—including its ability to support plant growth. The soil on earth provides nutrients and resources, purifies water, suppresses disease and pathogens, and sequesters carbon. We need a certain number and a certain diversity of living organisms in the soil in order for these services to be rendered. It's not sand, silt or clay that does that: it's the Organic matter.

POTENTIAL BENEFITS FROM INCREASING SOIL ORGANIC CARBON:

Soil is capable of storing large amounts of organic carbon. It is the largest terrestrial store of carbon. On average, the soil contains about three times more organic carbon than the vegetation and about twice as much carbon than is present in the atmosphere. Greater soil carbon helps to maintain soil structure by forming stable, larger aggregates that hold plant-available water in intra-aggregate pores and larger inter-aggregate pores that create greater soil permeability, aeration and drainage. Increasing soil carbon provides substrate and energy to support microbial activity, provides a reservoir of organic N, P and other nutrients for plant productivity and creates more physically cohesive soil to resist soil losses by wind or water erosion and by protecting occluded organic matter within the larger aggregates. In addition, plays vital role in mitigate climate change. Carbon can come out of the atmosphere and be stored in the soil, helping to re-balance the global carbon budget.The global production of three of the most important food crops are maize, wheat and rice could increase by up to 23.4 per cent, 22.9 per cent and 41.9 per cent respectively between 2020 and 2050, if organic carbon in all the world's agricultural soils were to increase by 0.4 per cent annually. The benefits of 0.4 per cent could result in increased resilience for vulnerable farming communities, and reduced exposure to projected risks associated with climate change such as floods, droughts and storms. This is due to enhanced soil biodiversity. Additionally, hydrological cycles also benefit from increased soil carbon. The capacity of soils to store water could increase by up to 37 billion cubic metre. The increase in soil moisture from 4‰ (parts per thousand) has the potential to reduce reliance on irrigation, with estimated global savings of $44 billion per year.