Soil Organic Carbon: A New Weapon in Carbon Fight

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Abstract— *Soil natural carbon is the base for soil richness. SOC is the piece of common carbon cycle, which releases supplements for plant development, helps for auxiliary, organic and physical soundness of the soil and for the most part goes about as a cradle against hurtful substances. Soil natural carbon levels are affected by soil sustenance, atmosphere, cultivating techniques, temperature, precipitation, arrive administration, and soil compose. SOC includes around 5% of mass of upper soil layer, as profundity expands its rate continues decreasing. SOC has capability of moderating environmental change and additionally to enhance soil wellbeing and ripeness. It lessens carbon rate in soil and this will decreases a dangerous atmospheric devation. Practices like discussion faming, enhanced product administration, kept up and enhanced tree administration, enhanced touching administration and expansion of natural materials are useful to expand the substance of SOC. The examination gives the data and great practices which underpins the completion appetite and accomplishes the objective and feasible improvement. This paper reviews the essential terms related with soil organic carbon and techniques to investigate the same. It likewise clarifies about its capability of decreasing the effects of an unnatural weather change and environmental change.*

Keywords—soil organic matter, global warming, climate change

I. INTRODUCTION

Soil natural carbon (SOC) is the carbon which enters the dirt after debasement of plants and creature deposits, root exudates, living and dead organisms and soil biota. Natural issue has a basic part in the physico-concoction and organic capacity of agrarian soil yet adds to just 3-10% of the soil mass. One of the quantifiable segment of soil natural issue is the carbon. Natural issue works in cation trade limit, soil structure, dampness maintenance and accessibility, debasement of toxins, ozone harming substance discharges and soil buffering. There are noteworthy carbon pools on earth primarily found in the world's outside layer, seas, environment and land-based biological communities. Soil contains around 2322 Gt of natural carbon. Soil natural carbon essentially originates from plants, creatures, microorganisms, leaves and wood. Changes in SOC content are influenced by numerous conditions and procedures like temperature, precipitation, vegetation, soil administration and land utilize design. Environmental change, nursery impact, a worldwide temperature alteration, ozone layer consumption, warm island impact are the difficulties for the present world. Soil fills in as a sink for the carbon dioxide and expanding focuses has co-benefits also.

Soil contains around 75% of aggregate biological system's carbon. SOC bolsters and controls the biological system benefits basically storm water penetration and supplement holding limit. Physical, compound and organic properties of soil are impacted by trees. Tree ranch sequesters the SOC levels over-the-ground and subterranean. Trees are the storage facility of natural carbon [1]. Vegetation and atmosphere firmly influence on the worldwide relative dissemination of SOC. As precipitation and dirt substance builds SOC increments however with increment in temperature SOC diminishes. SOC helps in soil fruitfulness and general agrarian generation. In shallow profundities, atmosphere assumes real part while in more profound profundities mud content is significant element [2]. The procedure of soil beginning on mine soil is significantly impacted by microbial activities and natural issue. Of around 1500 Gt of natural carbon is at a 1 m profundity and further 900 Gt of carbon is at 1-2 m profundity. Add up to soil natural carbon is straightforwardly identified with anthropogenic carbon dioxide produced. A worldwide temperature alteration is straightforwardly or by implication identified with soil natural carbon. Net essential generation and rate of deterioration are additionally the primary elements for soil natural carbon think about. Expanding air carbon dioxide is connected with both the variables specified previously. Little change in SOC prompts real effects of anthropogenic carbon transmitted. SOC decreases the carbon dioxide development and has a tendency to diminish a dangerous

atmospheric devation [3]. Increment in temperature lessens soil natural carbon and increment in carbon dioxide upgrades the capacity of carbon in the dirt. There is connection between soil quality and soil natural carbon. Extractive practices prompts corruption of soil fruitfulness and this will influence on agro based profitability. Practices identified with agrarian feasible incorporates expanding carbon pool, viable land utilize and administration frameworks [4].

II. TOTAL ORGANIC CARBON

It is the measure of carbon contained inside natural matter of soil. Add up to natural carbon changes different qualities of the dirt, for example, shading, supplement holding limit, supplement turnover and dependability. The commitment to cation trade from natural part in dirt is little as contrasted and sandy. In spite of the fact that natural part in earth is higher than sand. Microorganisms use natural carbon as their nourishment source. Rate of natural issue expansion influences on the measure of natural division in the dirt. TOC is shaped from corruption of plants and creatures.
Add up to Carbon = Organic carbon + Elemental carbon (inconsequential insoluble) + Inorganic carbon (carbonates and bicarbonates)

TOC likewise characterized based on portions that change in estimate and debasing capacity. There are three parts of the aggregate natural carbon to be specific inactive division, moderate portion and dynamic portion.

Inactive part – synthetically steady, sets aside long opportunity to turnover and biggest pool

Moderate part – contains natural mixes which are impervious to deterioration, turnover rate of 20-30 years

Dynamic part – littler pool that are for the most part used by organisms, begins from new living species, turnover rate of 2-3 years, 1.5% aggregate soil matter microbial structure, touchy

Add up to soil natural is limit of soil to supply supplements. At the point when soil contains more rock then less natural carbon and the other way around.

Greater part of soil natural carbon is dead and living creatures makes under 15% of soil natural issue pool.

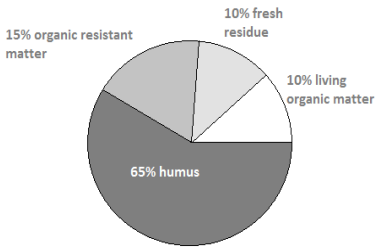

fig. Distribution of organic matter in soil

III. COMPUTAION OF SOC AND SOM IN THE SOIL

Soil natural carbon content in huge amounts of carbon per hector = add up to natural carbon content *mass of soil in given example

IV. SOIL NATURAL ISSUE CYCLING

There are different components which impact the natural issue data sources and decay, for example, soil write, atmosphere and administration. Precipitation influences on development and additionally on organic exercises.

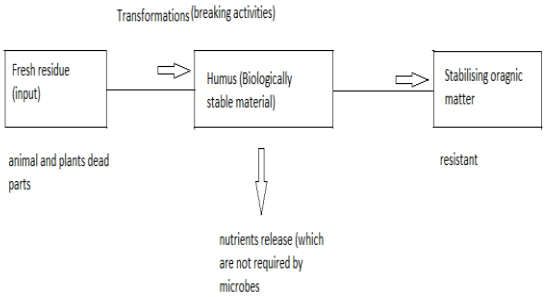

fig. soil organic matter recycling

V. AMOUNT SOC REMAINED IN THE SOIL AFTER ENTRY

From the total organic carbon available in organic residues, microbes consumes 90% of it. During this process, they release carbon back to atmosphere in the form of carbon dioxide and the 30% of organic inputs are converted into humus. Soil type, environment are the three main factors affecting the ability of a given soil type to retain SOC.

Factors affecting –

1) Type of soil – Clay type soil preserves the naturally occurring organic matter than course sandy soils.
2) Climate – Rainfall enhances soil organic matter as it supports the faster plant growth. Temperature also plays important role. At lower temperature, rate of decomposition of organic matter is slower and warm conditions prevails the rapid decomposition rates.
3) Land and soil management – organic matter inputs can be increased by maximizing crop and pasture biomass, protecting top 0-10 com of soils prevents surface from erosion, avoiding tillage of structured soil, adding off-farm organic residues, transfer of soil and organic matter down slope by erosion, avoiding strong acidic or alkaline conditions.

Soil organic carbon is hidden potential. Soil is one of the most vulnerable resource in the world. Soil contains higher percentage of carbon compared with atmosphere and terrestrial vegetation. Carbon from fauna and flora in the organic material form enters the soil and remains in the soil for decades and years. In the form of carbon dioxide and methane, eroded soil material, dissolved organic carbon washed in rivers and oceans carbon is lost. The study gives idea of importance of global carbon fluxes to get maximum benefits of environment.

SOC → food production, mitigation and adaption to climate change → sustainable development goals

Benefits of SOC –

- Improves soil structural stability
- Supports water filtration capacity of soil
- Ensures efficient aeration
- Improves water filtration rate
- Support plant growth

Of about 1500 PgC of SOC is found in first meter of soil. Peat lands or black soils are the SOC hole spots and dry lands are low SOC content area. Climate change and unsustainable management making these sources as a source of GHG emission, but wise management can leads to large amounts of carbon in the soil, which will contribute to mitigate and adopt to the climate change.

Climate change leads to –

- Threats to food security
- Affects crop, livestock and fishery production through yield reduction

- Biological reduction
- Loss of ecosystems services
- Reduction in agricultural incomes
- Increase in food prices

VI. METHODS TO ANALYZE SOC

1) Analytical method –

   Total carbon can be given as TOTAL CARBON = ORGANIC (C)+ INORGANIC (C)
   In soils and sediments, total carbon = inorganic + organic. Soils with no inorganics Total carbon = inorganic + organic
   In arid regions, greater concentration of carbon is from inorganic carbonates. In soil containing limestone, most of the inorganics may found.

2) Qualitative methods-

   It involves two methods namely Nuclear Magnetic Resonance Spectroscopy (NMR) and Diffuse Reflectance Infrared Fourier Transform (DRIFT) spectroscopy.
   NMR method is mainly for characterization of soil organic matter and for the study of humidification of soils. It works on the principle of measuring absorbed and re-emitted characteristic energy by atomic nuclei from static magnetic field.
   DRIFT method provides a rapid and cheap mean of differential carbon forms in solids and sediments when used in combination with multivariate data analysis.

3) Semi-quantitative methods –
   It includes two main methods loss-on-ignition (LOI) and Hydrogen peroxide digestion method. LOI deals with determination of organic matter by heated destruction of all organic matter in soil sample. Hydrogen peroxide digestion destructs organic matter in the sample by oxidation.

4) Quantitative methods –
   There are three methods involved in this such as destructive, non-destructive and gas chromatography.
   Destructive method – wet oxidation followed by titration, wet oxidation followed by by collection and measurement of carbon dioxide evolved, dry combustion at high temperature.
   Non-destructive method- non-elastic neutron scattering
   Gas chromatography – sample detection and quantitative analysis

VII. INTERPRETATION OF SOC RESULTS -

Changes in SOC are gradually happening, it is difficult to quantify little changes in vast foundation of soil carbon. For precise estimation of changes in natural carbon needs soil examining convention which sees all the characteristic varieties in soil carbon, estimation of SOC focus and estimation of mass thickness of soil. SOC changes are for the most part seen in topsoil of 0-10 cm. soil tests for natural carbon reports the level of aggregate SOC. At that point utilizing a measure of mass thickness, the measure of carbon per hector in a given profundity of output can be ascertained.

VIII. SOC AND CARBON SEQUESTRATION -

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide for longer duration so that it will mitigates the global warming and climate changes. SOC sequestration supports the mitigation of climate change and is the solution to warming climate. There are two types of terrestrial sequestration and geologic sequestration. SOC leads to sustainable agricultural by enhancing soil fertility. SOC sequestration deals with storing carbon in soil. And is considered as the strategy for climate change mitigation. As per the studies, it has been found that SOC sequestration mitigates about 5-14% of total annual GHG emissions for upcoming years. Management practices in agricultural field could increase productivity, profitability, conservation of resource bases and protection of environment.

SOC sequestration = Environment equilibrium level – current depleted level

There are some management practices which enhances SOC sequestration potential like crop management, conservation tillage, pasture management, organic amendments, land conversion and soil improvement.

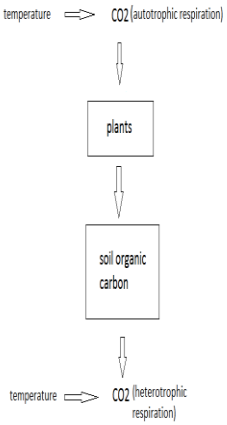

Fig. Relationship of SOC with temperature and carbon dioxide

IX. CARBON POOLS -

There are three carbon pools are labile, less labile and inert fractions. Labile pool consist of soil organisms, polysaccharides, cellulose, and hemicellulose with half-life varying from weeks to months. Less labile includes lignins, lipids polymer, resins, fats, waxes, humidified products with half-lives varying from years to decades. Inert fractions are charcoal, pyrolysed carbon with half-lives from centuries to millennia.

The percentage of carbon in all the three forms is mainly affected by the quality of organic matter and decomposition products. The percentage of SOC in ecosystem is controlled by climate, soil, vegetation, time, balance between carbon inputs and losses.

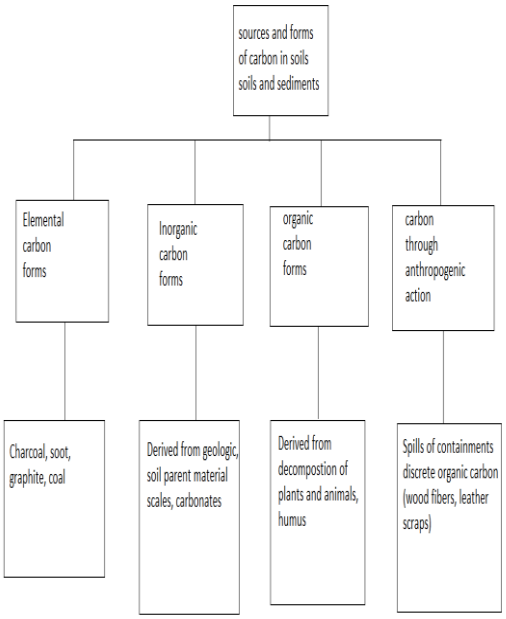

Fig. carbon sources and its forms

X. CONCLUSION

Soil natural carbon content is one of the key soil properties related with numerous soil capacities. It is a wellspring of supplements and is pivotal for horticultural generation. Increments in SOC stock expands edit yields in high-input business farming, however, particularly in low-input debased land. SOC saving practices have most extreme capability of environmental change relief and upgrade of sustenance efficiency.

Given the part of soils in environmental change moderation and adjustment and the confinements exhibited by SOC immersion in sequestering extra carbon inputs, reasonable soil administration should be executed to guarantee that a soil is rendered a sink rather than a hotspot for climatic CO2. Along these lines, it is perfect to think about and decide, for any given biological community, both the current SOC stocks and the individual carbon immersion point to decide a soil's carbon sequestration potential.

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