Soil's Organic Carbon

Mains: *GS III - Environment*

Why in News?

A recent detailed study conducted by the Indian Council of Agricultural Research (ICAR), has found that the unscientific use of fertilisers and climate change are contributing to degradation of organic carbon in arable areas of the country.

What is soil organic carbon?

- **Definition –** SOC is the carbon found in all stages of decomposition of organic residues in the soil.
- It is the major component of soil organic matter (SOM), making up about 58% of its mass.
- **Composition –** It includes a mix of compounds from fresh plant remains to more stable forms like humus and charcoal.
- **Formation –** It enters the soil primarily through photosynthesis, where plants convert atmospheric carbon dioxide, into organic compounds that are then added to the soil through roots, leaves, and other organic materials.

What is the importance of soil organic carbon?

- **Soil health and fertility –** Improves soil structure by helping soil particles clump together, which creates a crumbly texture and promotes better root expansion.
- Increases water holding capacity, providing plants with more available water.
- Serves as a source of nutrients for plants and a food source for soil organisms.
- **Environmental benefits –** It has several environmental benefits such as
- **Carbon sequestration –** Soils are the largest terrestrial carbon pool, and SOC acts as a carbon sink, absorbing and storing carbon from the atmosphere and helping to mitigate climate change.
- **Heat absorption** – If there is more carbon in soil, then there is more heat absorption.
- If the carbon content is lower, then the heat absorption in the soil will be less, and there will be more heat reflection from the ground creating greenhouse gas effect.
- **Climate resilience –** A healthy amount of SOC can help plants withstand extreme weather events like floods and droughts.
- **Water purification –** Soils with high carbon content are better able to filter and purify water.

What is the recent study?

- **Conducted by** – The study, primarily coordinated by the ICAR's Indian Institute of Soil Science in Bhopal.
- They covered 20 agro-ecological regions.
- **Samples used** – They have used 254,236 soil samples of 620 districts covering 29 States to reach the conclusions.
- **Mapping** – The team of scientists developed an 'agri-ecological base' map to assess the impact of cropping systems and the use of fertilisers on organic carbon.
- **Research paper** – It is based on the six-year-long study started in 2017 has been published now in the England-based international research journal '*Land Degradation & Development.'*

What are the findings of the study?

- **Nutrient –Carbon relationship –** The study has found that if the organic carbon is low, then the deficiency of micronutrients in the soil is high, and if the organic carbon is high, the deficiency is low.
- **3 important factors** – The study noted that irrespective of the crops and cropping patterns, *temperature, rainfall and elevation* are the three important factors which decide the organic carbon concentration in the soil.
- **Impact of latitude** – If the elevation of the land is high, then the organic carbon content is high.
- But if we move from hills to low land, then the organic carbon content is low.
- Influence of Rainfall – Rainfall will not have a significant impact, but with the temperature, it is highly negatively correlated.
- **Effect of temperature** – Organic soil carbon is negatively correlated with temperature.
- If the temperature is rising, then there are chances that soil organic carbon will decline further in future.
    - **For example**, in Rajasthan and Telangana, the temperature is very high and their organic carbon content is low.
- **Influence of cropping pattern** – The cropping system is very, very important in deciding the organic carbon content within the regions.
    - Wherever rice-based cropping systems or pulse-based systems are there, the organic carbon content is a bit higher than the areas that followed wheat and coarse-grain cropping systems.
- For rice, where we have to apply more water, the microbial activities are very high, helping in in sequestering more carbon in soil.
- The scientists have prepared a map which can help in making policy decisions, particularly for the carbon credit and assessing the land degradation.
- They have also addressed questions such as rice food system has degraded the land and the extent of its degradation.
- **Effect of fertilizers** – Wherever Imbalanced fertiliser application was there, then the organic carbon contained in the soil had declined.
    - *Haryana, Punjab, and parts of Western Uttar Pradesh* have intensified the fertiliser application,has negatively impacted organic carbon in the soil.

    - But in States like Bihar, where balanced application of fertilisers can be seen, the situation is better.
- **Consequence of climate change** – It will have an impact on organic carbon, the study noted.

What lies ahead?

- The scientists have suggested that the country should cover all the soils with crops and should try to establish a large number of plantations in the country.
- Wherever soils have very low carbon, less than 0.25%, the governments should promote organic carbon sequestration so that farmers can develop some sort of a cropping system, with increased irrigation facilities.
- We should give incentives to these farmers, who are able to trap more carbon dioxide from the soil, and they are converting it into organic carbon.
- We must find out different crop management options for climate change mitigation.

Reference

The Hindu| SOC and its Importance