SOIL CARBON: A SOLUTION TO THE CHANGING CLIMATE AND CARBON DIOXIDE MITIGATION

VARSHA PANDEY

Ph.D. Scholar, Department of Soil Science, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand
*Corresponding author, E-mail: varshapandey.p93@gmail.com

The UN Secretary-General António Guterres in his address to the UN General Assembly in 2018, said that "Climate change is moving faster than we are". It is already affecting people, ecosystems and livelihoods all around the world. The climate of the earth is constantly changing due to a variety of factors and one of the major reasons includes changes in greenhouse gases concentration. The green house gases (GHG's) present in the atmosphere trap some of the short wavelength radiations emitted by the sun and reradiated as heat (long wavelength radiations). As the concentration of GHG's increases, more heat is trapped by these gases, like the glass walls of green house, and hence the name green house effect. This leads to elevation in the earth's surface temperature thus causing global warming (Figure 1).

WHY DOES CO_2 NEEDS SPECIAL ATTENTION?

The major GHG's are carbon dioxide, methane, nitrous oxide and water vapour. But, there is greater focus on CO_2 as it is more abundant in the atmosphere and stays for a much longer time. Although water vapour is the most abundant greenhouse gas, it has a very short cycle in the atmosphere which is on an average around ten days after which it is incorporated into the various weather events.

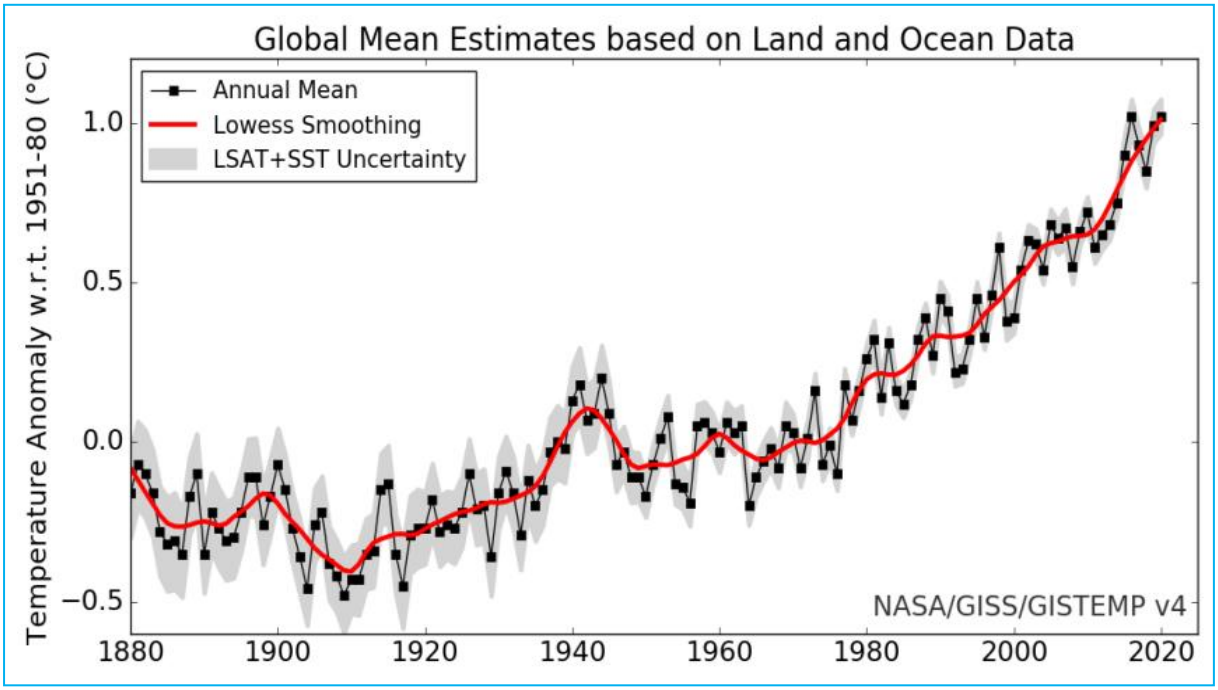

Figure1: Global mean temperature rise (Source: https://data.giss.nasa.gov/)

In its global climate assessment report, 2013, Intergovernmental Panel on Climate Change (IPCC) calculated the "radiative forcing" (RF) or "climate forcing" of the gases in the atmosphere. Radiative forcing is the difference between sunlight absorbed by the earth's surface and the energy radiated back to space. Positive radiative forcing will cause warming of the earth's surface. Of all the human influenced climate drivers compared by the IPCC, CO_2 has the highest positive RF indicating that it has contributed most to climate change. Therefore, CO_2 adds to the greenhouse effect in a unique way and needs special attention.

Global Monitoring Laboratory data shows atmospheric carbon dioxide (CO_2) concentration as 280 ± 10 ppm during the pre industrial era. Further, it has increased to 367 ppm in 1999, 400 ppm in 2015 and in 2018 the global average atmospheric carbon dioxide is 407.4 ppm (https://www.esrl.noaa.gov/gmd/ccgg/trends/).

SOIL AS A GLOBAL CARBON POOL

Soil is considered to be the third largest global carbon pool. Soils are one of the basic resources for sustenance of life on our planet earth. It is a major reservoir of carbon. Soil organic carbon is very precious and a valuable resource for sustaining the agriculture ecosystems and ultimately life. The soil C pool comprises mainly soil organic C (SOC) and soil inorganic C (SIC) (Figure 2). SOC is estimated at about 1550 Pg (1 petagram= 10^{15}g=1 billion metric tones=1 gigatonnes) and SIC at approximately 750-950 Pg up to 1-m depth (Batjes, 1996; Lal, 2016). But, there may be variation in this amount depending on the rate of photosynthetic carbon fixation and the rate of its decay.

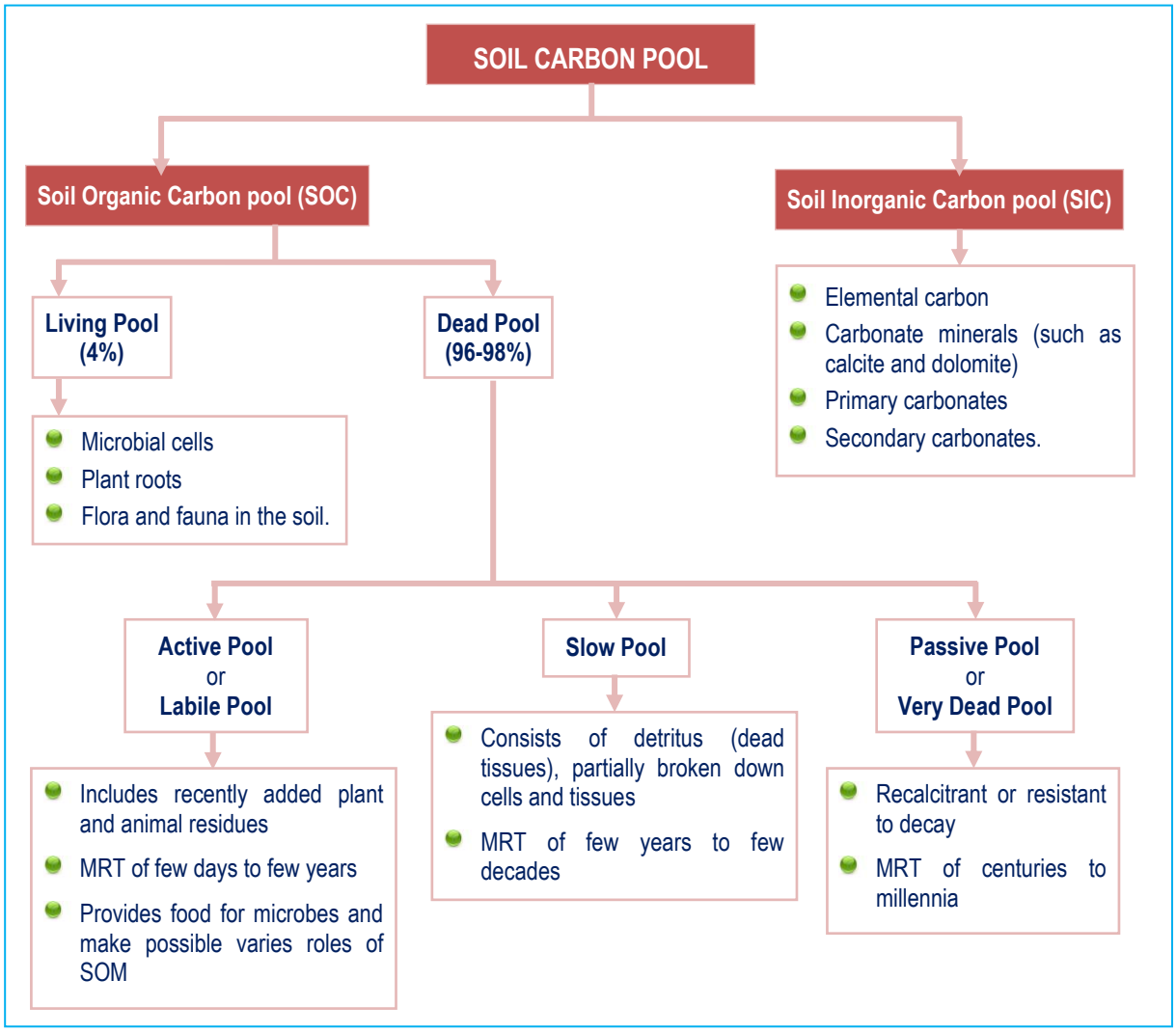

Figure 2: Organic and inorganic soil carbon pool

SOIL CARBON SEQUESTRATION

The soils of the world serve as a sink as well as a source of atmospheric carbon. One of the strategies available for lowering CO_2 emissions to mitigate climate change is carbon sequestration from the atmosphere i.e. sequestering of carbon in the plant biomass or soil. Plants take up carbon dioxide from the atmosphere through the process of photosynthesis and carbon is incorporated into living plant matter. With the death of plants, leaves, stems and roots decay and decompose in the soil and become soil organic matter. This basic process is called as soil Carbon Sequestration.

According to IPCC "carbon cycle" is "the term used to describe the exchange of carbon (in various forms, e.g., as carbon dioxide) between the atmosphere, ocean, terrestrial biosphere and geological deposits". Atmospheric concentrations of carbon dioxide can be lowered either by reducing emission of GHG (by fossil fuel combustion, deforestation or human induced soil degradation) or by taking carbon dioxide out of the atmosphere and storing in terrestrial, oceanic or freshwater aquatic ecosystems.

According to Lal (2016) there are about 2700 Gt of carbon which is stored in the soils worldwide. This is considerably more than the combined total of 780 Gt in the atmosphere and 575 Gt in the biomass. Total soil carbon sequestration potential of India is 39.3-49.3 Tg C $year^{-1}$. General strategies for sequestration of carbon are given in the Figure 3.

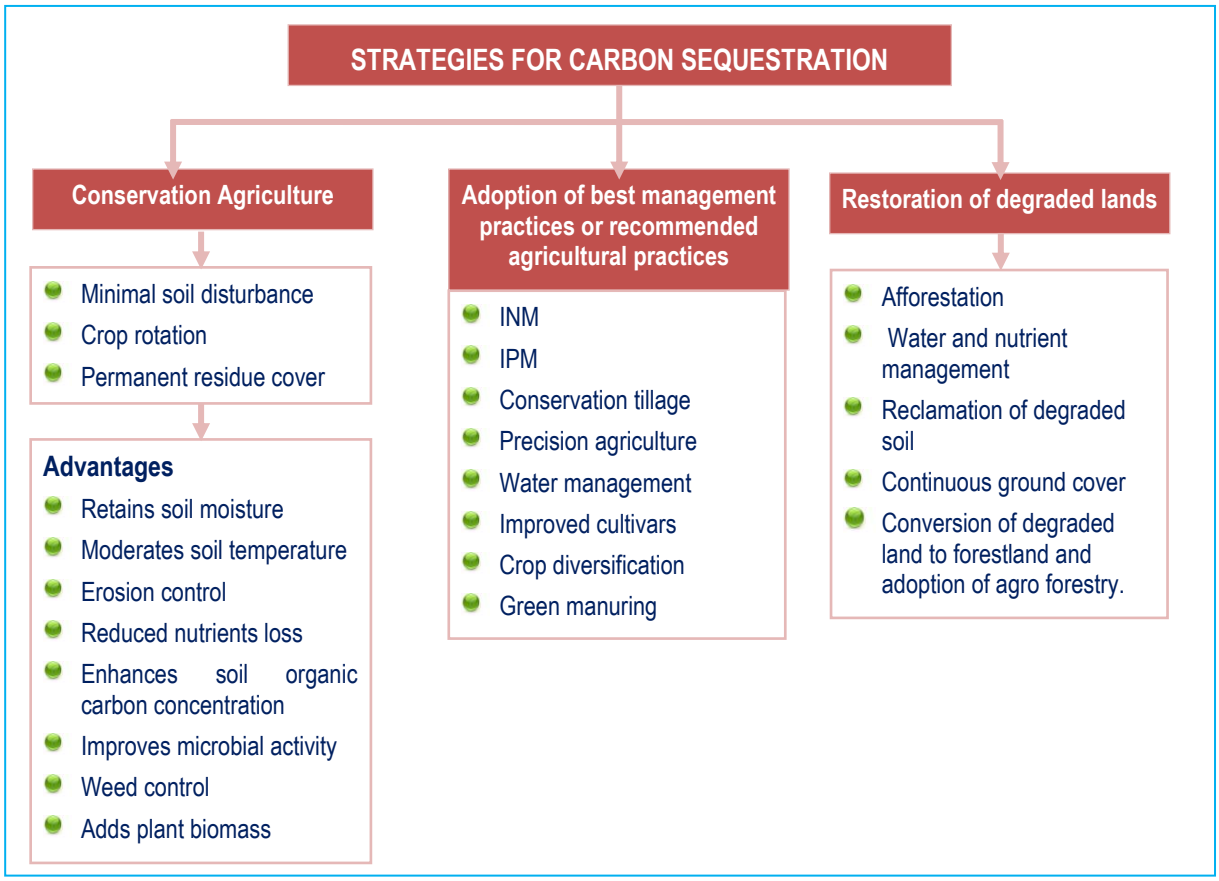

Figure 3: General Strategies for C sequestration

4 PER THOUSAND INITIATIVE

The importance of management of global soil carbon pool can be seen by the "4 per 1000" international initiative which was launched by the French Government on 1st December 2015 at the 21st Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC) as part of the Lima-Paris Action Plan. It is an initiative which is a crucial step in the right direction. The program aims at an annual growth rate of 0.4% in the soil carbon stocks in the first 30-40 cm of soil. 0.4% (four parts per thousand) a year is the rate of carbon sequestration in

soil that is needed to help mitigate climate change. This would significantly reduce the CO_2 concentration in the atmosphere. It shows that even a small increase in soil carbon is crucial to mitigate the climatic changes that are taking place and also to enhance the fertility of soil.

CONCLUSION

If the earth's atmosphere lacked the green house gases, earth's average temperature would be -18 ° C instead of 15 ° C. This indicates that green house effect is not completely a bad thing as it is needed for the sustenance of life on our planet. But, excess of everything is harmful and so is with the GHG's. Carbon sequestering is one of the effective solutions for climate change mitigation. Although, it will not have an immediate effect, it can help for a longer period of time. In fact, planting a tree by every person may not seem important right now but over time it can significantly reduce the amount of CO_2 in the atmosphere.

REFERENCES

Batjes, N.H. (1996). Total C and N in soils of the world. *European Journal of Soil Science*, 47:151-163.

Lal, R. (2016). Soil health and carbon management *Food and Energy Security*, 5(4): 212–222.

**