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Restore Soil Health: Revive the Climate

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SUMMARY

There is a sharp increase in atmospheric concentration of CO2 by 31% since 1750s causing climate change. Restoring soil health to aid carbon sequestration is one big solution, which is possible through proper land use. Carbon is considered to be the key factor for climate change. Thus, when we choose to adopt techniques for restoration of soil health like adoption of recommended management practices (RMPs) it must have the capacity to reduce the rate of enrichment of atmospheric CO2 while addressing issues like sustainability. Some part of the depleted SOC pool can be restored through conversion of marginal lands into restorative lands, adoption of conservation tillage with cover crops and crop residue mulching, nutrient cycling, and other systems of sustainable management. The pools which sequester carbon contents for long term have to be replenished over-time, hence, the restoration process is time-consuming but definitely a solid step towards mitigating climate change.

INTRODUCTION

"A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people." -- Franklin D. Roosevelt. As we all know that our planet is gradually warming, all from the North Pole through the equator towards the South Pole and is further taking peak with every passing year. Since 1906, the global average surface temperature has been increasing by more than 1.6 degrees Fahrenheit (0.9 degrees Celsius)—even more in the sensitive polar regions. The effects are heart-wrenching and is right before our own eyes . The phenomenal heat is melting glaciers and ice from the seas, shifting precipitation patterns, and setting animals on the move, compelling migratory birds' to abandon their habitats ,and what not! Most of these changes are emerging fast as we humans are continuing to add heat-trapping greenhouse gases to the atmosphere.

Climate Change: What is it and How it Occurs ?

Carbon – usually in the form of carbon dioxide (CO_2) – is the main factor in climate change. The atmospheric concentration of carbon dioxide (CO_2) has increased by 31% since 1750. The present CO_2 concentration has not been exceeded during the past 420,000 years and likely not during the past 20 million years. Around three quarters of the anthropogenic emissions of CO_2 to the atmosphere during the past Climatic Change is due to fossil fuel burning. The rest is predominantly due to land-use change, especially deforestation (IPCC, 2001).Earth's soil contain around 2,500 gigatons of carbon—which is more than three times the atmospheric carbon and four times the amount stored in all biota. In the United Nations Framework Convention on Climate Change (UNFCCC), climate change is defined as a 'change of climate which is attributed to human activity that alters the composition of the global atmosphere.

The UNFCCC's objective is to achieve 'stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' .For example, Iceland is a country where vast amounts of stored carbon have been released to the atmosphere due to degradation of woods and rangelands. If we happen to restore these degraded lands to sustainable woodlands and fertile grazing lands, we would add to the survival the ongoing presence of significant carbon sinks (Arnalds,2004).

Mitigating Climate Change Through Soil Restoration

"Thinking about ways to increase soil carbon storage is a really important weapon in the arsenal [against climate change]," said Ben Taylor, an ecosystem ecologist and Ph.D. candidate in Columbia University's Department of Ecology, Evolution and Environmental Biology. The carbon which is stored in soils is greater than all the carbon in our biomass and the atmosphere combined, so even minute changes in that pool would have

tremendous effects for us.The real struggle lies in figuring out how to manage that soil carbon pool size ; if it's done – the solution to combat climate change is on our hands !.

In this regard, Carbon sequestration is one of the strongest tools available in mitigating the potential risk of climate change which is possible through proper soil restoration activities. The operational details of the Kyoto Protocol to the Convention CARBON SEQUESTRATION AND THE RESTORATION OF LAND HEALTH 337 on Climate Change were finalized in 2001, despite considerable controversy from the eminent personalities and organizations. At the end, it was decided that countries included in Annex I to the Protocol may choose to use carbon sinks created after 1990 by revegetation, forest and cropland management and grazing land management in addition to afforestation and deforestation, to meet the country commitments to combat climate change. The amount of carbon stored by the soil and how long they can store varies location-wise (spatial) and is determined by how effectively the land is managed. Since almost half of the land that can support plant life on Earth has been converted to grazing grounds, croplands, pastures and rangelands, soils have actually lost 50 to 70 percent of the carbon they once held. This has contributed about a quarter of all the anthropogenic global greenhouse gas emissions that are warming the planet at an alarming rate.

Hence, maximum efforts has to be put on use of lands in such a way that leads to lesser use of tillage activities, conservation or zero tillage activities ,lesser planting of mono-crops, lesser biomass burning, adding crop residue, afforestation, minimum use of fertilizers and pesticides and lesser conversion of grasslands to grazing grounds, which will expose lesser of the carbon in the soil to oxygen, allowing lesser of it to burn off into the atmosphere and storing more of it in the soil . A large amount of CO_2 is stored at the deeper depths of the soil. The soil acts as an absorber of $C0_2$, hence the carbon dioxide released from the atmosphere can be stored well in the soil sink. But it is a fact that microbial decomposition releases carbon dioxide, so the soil can store more carbon when it is protected from microbial activity. One key way through which it happens is through the formation of soil aggregates.

This occurs when tiny particles of soil clump together, sheltering carbon particles inside them. Mycorrhizal fungi, which produce sticky compounds that facilitate soil aggregation, are able to transfer 15 percent more carbon into the soil than other microbes. Soils with high clay content are also able to form chemical bonds that protect carbon from microbes. These aggregates give soil its structure, which is essential for healthy plant growth. Hence ,if soil health is restored, through addition of crop residues , growing of cover crops ,cultivating diversified crops and as the organic matter of the soil would increase, there would be more chances of carbon being sequestrated and thereby, it has the potential of decreasing carbon content in the atmosphere to a great extent. Some amount of carbon, sequestrated mainly from plant residues and the carbon exuded by plant roots, remains in soil only for a few days to a few years. Microbes can easily digest this "fast pool" of carbon, so it emits a large amount of carbon dioxide, thereby increasing carbon content of soil abundantly in a short time. The "slow pool," where carbon can remain for years to decades, is composed of decomposed plant material, microbial residues from the fast pool and some complex carbon molecules that are protected from microbes. A third "stable pool," comprised of humus—partially decomposed organic fraction of the soil—adds soil carbon that is well protected from microbes, is found below one meter deep and can retain carbon for a very long time.

Application of manure and compost has been found to increase soil productivity and the formation of stable carbon that can remain in the soil for decades. For example, the Marin Carbon Project found that a single time application of compost increased the soil's carbon content continually, at a rate comparable to removing 1.5 metric tons of carbon from the atmosphere every single year. Wetlands are considered to be a store-house of nutrients and moisture, which can contribute as a sink in carbon sequestration and fighting climate change. Maintaining hydrology, reducing pollution, controlling exotic vegetation, and protecting the wetland's biological diversity and integrity are important activities to maintain and improve the resiliency of wetland ecosystems so that they continue to provide important services under changed climatic conditions .If we analyse the situation, it can be seen that the Sundarban (Bangladesh and India), Mekong river delta (Vietnam), and southern Ontario (Canada) are examples of major wetland complexes where the effects of climate change are evolving in different ways(Erwin,2009). Thus, successful long term restoration and effective management of these soil-water systems will bring on new ideas on how we choose to respond to the effects of climate change and in future, how we can tackle climate change in different ways : hence soil system restoration is the key to all future endeavours.

CONCLUSION

If a well-coordinated and sustainable SOC sequestration program could be implemented at a global scale,probably it could at the same time increase agricultural productivity especially in developing countries, and counteract climate change. It is thus important on the part of international organizations (e.g., FAO, UNDP, World Bank), developing countries concerned with food security (e.g., subSaharan Africa, South Asia), and industrialized countries concerned with climate change and environment pollution (e.g., U.S., Canada, Europe, Japan, Australia) join forces and implement comprehensive programs to restore degraded soils to sequester C and enhance productivity and fight back climate change ,in general (Lal,2005).

Thus, the following issues needs to be addressed :

1.How the C pools should be maintained in soil?

2.How are the pools affecting to the contribution of Carbon content in soil and which pool actually sequesters highest amount of carbon?

3.Which are the precise methods of restoring soil health that helps to trap carbon for a longer time and helps in mitigating climate change?

4.How far are the environmentalists, organizations, agricultural researchers ,scientists ,farmers and even the general population bothered about restoring soil health to mitigate climate change?

5.Are we ready to give up on our current lifestyle, building up of lawns and buildings ,entertainment parks that are built out of the hardy trees holds the soil, or by hellish acts of mass deforestation, land clearing and increase human to nature interaction instead of only working upon only human to human?

Addressing these issues, will in itself, be a solution to mitigate climate change.Even though,carbon sequestration is not a long-term solution to this problem of climate chnge,however this will be the bridge that will connect the human health to the soil health, thereby a step closer to solving the problem. Restoration of soil through organic methods is definitely a time consuming process , but will eventually make this earth immune to any further degradation. Soil health restoration shouldn't be an option, rather a choice, a way of life, leading to the new normal and forgetting the old normal which just focussed on productivity. "Climate justice demands that the little carbon space we still have, developing countries should have enough room to grow," said our PM Narendra Modi, a key player because of our country's size and its heavy dependence on coal.If soil survives ,everything else will flourish.Hence, increasing SOC content through sequestration will definitely cut the atmospheric carbon content to a considerable amount, thereby aiding us in our battle against climate change.

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