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Suresh Kumawat
Department of Soil Science & Agricultural Chemistry, Swami Keshwanand Rajasthan Agriculture University, Bikaner, Rajasthan, India

Sundar Anchra
Department of Agronomy, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Shiv Chand Bawaliva
Department of Soil Science & Agricultural Chemistry, Swami Keshwanand Rajasthan Agriculture University, Bikaner, Rajasthan, India

Sumitra Kumawat
Department of Soil Science & Agricultural Chemistry, Swami Keshwanand Rajasthan Agriculture University, Bikaner, Rajasthan, India

Corresponding Author:
Suresh Kumawat
Department of Soil Science & Agricultural Chemistry, Swami Keshwanand Rajasthan Agriculture University, Bikaner, Rajasthan, India

Impact of fertilization with organic sources on carbon sequestration under different cropping system

Suresh Kumawat, Sundar Anchra, Shiv Chand Bawaliva and Sumitra Kumawat

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Abstract
With the changing climatic scenario, reduction in CO_2 in atmosphere will be viable solution to reduce air temperature as well as production of temperature sensitive crops. Carbon sequestration is a new area for researchers. It is process by which carbon dioxide is taken out from the Earth's atmosphere and afterward stored into the soils. Most soils of agroecosystems having lower C pool than under natural vegetation cover. Some severely depleted and strongly eroded soils may have lost as much as 75% of the antecedent pool (Lal 2004). Thus, soils of agroecosystems have a C sink capacity which can be filled by sequestration of atmospheric CO_2 as SOM and as secondary carbonates. With the increasing carbon content in soil, will leads to enhance chemical, physical and biological properties of soils. In India, lots of organic waste is available in urban as well in rural area. This can help to reduce the cost of cultivation by reducing the dependency on chemical fertilizer such as potassic and phosphate fertilizer those are mostly imported from foreign countries. Many authors have been reported that applications of organic fertilizer with organic sources were significantly improved different soil carbon pools as well as soil quality and soil health (Mandal *et al*., 2007; Benbi *et al*., 2012: Sofi *et al*., 2016). In the conclusion of this presentation, I would like to say sequestration of C into the soils improve the productivity and sustainability of soil

Keywords: Agroecosystems, secondary carbonates, potassic

Introduction
What is Carbon Sequestration?
Carbon sequestration is both a natural and artificial process by which carbon dioxide is removed from the Earth's atmosphere and then stored in soil. It is a process of capture and deliberates, whether natural or artificial, storage of CO_2 over a long period of time. The initial purpose of doing this is to delay global warming and avoid extreme climate change.

Ways that carbon can be stored (sequestered):
1. In plants and soil “terrestrial sequestration” (“carbon sinks”)
2. Deep in ocean “ocean sequestration”
3. Underground “geological sequestration”

1. Terrestrial carbon sequestration
The process through which CO_2 from the atmosphere is absorbed naturally through photosynthesis and stored as carbon in biomass and soils.Terrestrial sequestration (now and then named "natural sequestration") is regularly cultivated through backwoods and soil preservation rehearses that improve the capacity of carbon, (for example, reestablishing and setting up new woods, wetlands, and fields) or decrease CO2 emanations (like lessening agrarian culturing and stifling out of control fires).In the United States, these practices are executed to meet an assortment of land-the board goals. Albeit the net earthbound take-up transitions offset around 30% of U.S. non-renewable energy source CO2 outflows, just a little part of this take up outcomes from exercises attempted explicitly to sequester carbon. The biggest net take-up is expected fundamentally to progressing normal regrowth of woods that were reaped during the 19th and early 20th centuries.

Existing terrestrialcarbon stockpiling is defenseless to aggravations like fire, illness, and changes in environment and land use. Boreal backwoods and northern peatlands, which store almost a large portion of the all out earthly carbon in North America, are as of now encountering generous warming, bringing about enormous scope defrosting of permafrost and emotional changes in oceanic and timberland environments. USGS researchers have assessed that something like 10 gigatons of soil carbon in Alaska is put away in natural soils that are incredibly defenseless against fire and decay under warming conditions. The limit of earthly biological systems to sequester extra carbon is dubious. An upper gauge of likely earthbound sequestration in the U.S. may be the measure of carbon that would be aggregated if U.S. backwoods and soils were reestablished to their noteworthy levels before they were exhausted by logging and development. These sums (around 32 and 7 gigatons for backwoods and soils, separately) are most likely not achievable by conscious sequestration since rebuilding on this scale would dislodge a huge level of U.S. horticulture and upset numerous other present-day exercises. Choices about earthbound carbon sequestration require cautious thought of needs and tradeoffs among different assets. For instance, changing farmlands over to woodlands or wetlands might build carbon sequestration, improve untamed life living space and water quality, and increment flood stockpiling and sporting potential–however the deficiency of farmlands will diminish crop creation. Changing over existing protection terrains to serious development, while maybe creating important yields (for instance, for biofuels), may lessen untamed life territory, decrease water quality and supply, and increment CO2 outflows. Researchers are attempting to decide the impacts of environment and land-use change on potential carbon sequestration and biological system benefits, and to give data about these impacts to use in asset arranging.

2. Ocean carbon sequestration

The world's seas are the essential long haul sink for human-caused CO2 discharges, presently representing a worldwide net take-up of around 2 gigatons of carbon yearly. This take-up isn't an aftereffect of purposeful sequestration, however happens normally through compound responses among seawater and CO2 in the air. While engrossing air CO2, these responses cause the seas to turn out to be more acidic. Numerous marine living beings and environments rely upon the development of carbonate skeletons and residue that are defenseless to disintegration in acidic waters. Research facility and field estimations demonstrate that CO2-instigated fermentation may ultimately make the pace of disintegration of carbonate surpass its pace of arrangement in these biological systems. The effects of sea fermentation and intentional sea preparation on beach front and marine food networks and different assets are ineffectively perceived. Researchers are contemplating the impacts of maritime carbon sequestration on these significant conditions.

3. Geological sequestration

Geologic sequestration starts with catching CO2 from the exhaust of fossilfuel power plants and other significant sources. The caught CO2 is channeled 1 to 4 kilometers beneath the land surface and infused into permeable stone developments. Contrasted with the paces of earthly carbon take-up geologic sequestration is presently used to store just modest quantities of carbon each year. A lot bigger paces of sequestration are imagined to exploit the possible changelessness and limit of geologic stockpiling. The changelessness of geologic sequestration relies upon the adequacy of a few CO2 catching components. After CO2 is infused underground, it will rise lightly until it is caught underneath an impermeable boundary, or seal. In principle, this physical trapping mechanism, which is identical to the natural geologic trapping of gasandoil can retain CO_2 for thousands to millions of years. Some of the injected CO_2will ultimately break down in ground water, and some might be caught as carbonate minerals shaped by synthetic responses with the encompassing stone. These cycles are defenseless to change after some time following CO_2 infusion. Scientists are studying the permanence of these trapping mechanisms and developing methods to determine the potential for geologically sequestered CO_2 to leak back to the atmosphere. The limit with regards to geologic carbon sequestration is compelled by the volume and conveyance of potential stockpiling locales. As indicated by the U.S. Branch of Energy, the all out capacity limit of actual snares related with exhausted oil and gas supplies in the United States is restricted to around 38 gigatons of carbon, and is geologically appropriated in areas that are far off from most U.S. petroleum derivative force plants. The likely U.S. capacity limit of profound permeable stone arrangements that contain saline ground water is a lot bigger (assessed by the U.S. Branch of Energy to be around 900 to 3,400 gigatons of carbon) and all the more generally conveyed, yet less is thought about the adequacy of catching components at these destinations. Unmineable coal beds have additionally been proposed for potential CO2 stockpiling, yet more data is required about the capacity attributes and effects of CO2 infusion in these developments. Researchers are creating strategies to refine evaluations of the public limit with respect to geologic carbon sequestration. To completely evaluate the potential for geologic carbon sequestration, financial expenses and natural dangers should be considered. Framework costs will rely upon the areas of appropriate stockpiling destinations. Ecological dangers might incorporate seismic unsettling influences, misshapening of the land surface, pollution of consumable water supplies, and unfriendly consequences for environments and human wellbeing. Researchers are spearheading the utilization of new geophysical and geochemical strategies that can be utilized to expect the likely expenses and natural impacts of geologic carbon sequestration.

Why carbon sequestration is important?

1. Carbon dioxide capture and sequestration could play an important role in reducing greenhouse gas emissions into the atmosphere.
2. It enables low-carbon electricity generation from power plants.
3. As reported by INCCA (Indian Network on Climate Change Assessment)in their report, 'Green House Gas Emission2007', 38% of CO2 emissions in India is done from electric power generation. This carbon share can be reduced by using carbon sequestration technology.
4. Carbon sequestration technologies can dramatically reduce CO2 emissions by 80-90% from power plants that burn fossil fuels.
5. Another reason of importance is, forests, which acts as carbon sinks and store Co2 in large amount.

Potential of Carbon Sequestration in World Soils [0.4 - 1.2 Gt C/yr]

Restoration of Degraded and Desertified Soils: 1.1 billion ha [0.2 to 0.4 Gt C/yr]

- Erosion control by water(100-200)
- Erosion control by wind (50-100)
- Afforestation on marginal lands(50-300)
- Water conservation/harvesting(100-200)

Cropland Soils: 1350 Mha [0.4 to 0.8 Gt C/yr]
- Conservation tillage (100-1000)
- Cover crops (50-250)
- Manuring and INM (50-150)
- Diverse cropping systems (50-250)
- Mixed farming (50-200)
- Agroforestry (100-200), Acid savanna soils, 250 Mha in South America, have a high potential

Range Lands and Grass Lands: [0.01 to 0.3 Gt C/yr?]*
3.7 billion hactare in semi-arid and subhumid regions
- Grazing management (50-150)
- Improved species (50-100)
- Fire management (50-100)
- Nutrient management
- *Both SOC and SIC are sequestered

Irrigated Soils: 275 Mha [0.01 to 0.03 Gt C/yr]*
- Using drip/sub-irrigation
- Providing drainage (100-200)
- Controlling salinity (60-200)
- Enhancing water use efficiency/water conservation (100-200)
- Both SOC and SIC are sequestered

These parameter show that the Ecosystems with a high and attainable soil C sequestration potential are cropland, grazing/range land, degraded/desertified lands, and irrigated soils. Forest soils are included under afforestation of agriculturally marginal and otherwise degraded/desertified soils. Reforestation of previously forested sites have small additional soil C sequestration. The potential of C sequestration of range lands/grassland is not included in the global total because part of it is covered under other ecosystems, and there are large uncertainties. Rates of C sequestration given in parentheses are in kg C/ha per year, are not additive, and are low under on-farm conditions. [Rates are cited from (2–9, 15, 25, 37–39) and other references cited in the supporting material.]

Strategies of soil carbon sequestration
A few cultivating practices and innovations can decrease ozone harming substance outflows and forestall environmental change by improving carbon stockpiling in soils; safeguarding existing soil carbon; and lessening carbon dioxide, methane and nitrous oxide outflows.

Conservation tillage and cover crops Conservation
Culturing alludes to various methodologies and procedures for building up crops in the buildup of past crops, which are deliberately left on the dirt surface. Decreasing culturing diminishes soil aggravation and mitigates the arrival of soil carbon into the air. Preservation culturing additionally further develops the carbon sequestration limit of the dirt. Extra advantages of protection culturing incorporate further developed water preservation, diminished soil disintegration, decreased fuel utilization, diminished compaction, expanded planting and gathering adaptability, decreased work prerequisites and further developed soil tilth.

Improved cropping and organic systems
On-going reports have researched the capability of organic farming to lessen ozone harming substance outflows (Rodale Institute, 2008). Organic systemsof creation increment soil natural matter levels using treated the soil creature composts and cover crops. Organic trimming frameworks additionally dispose of the emanations from the creation and transportation of manufactured manures. Parts of organic agriculturecould be executed with other manageable cultivating frameworks, like protection culturing, to additional expansion environmental change moderation potential.

Irrigation and water management
Upgrades in water use productivity, through measures like water system framework mechanical upgrades combined with a decrease in working hours; dribble water system advancements; and focus turn water system frameworks, can fundamentally decrease the measure of water and nitrogen applied to the editing framework. This decreases nursery discharges of nitrous oxide and water withdrawals.

Land restoration and land use
Changes Land reclamation and land use changes that energize the preservation and improvement of soil, water and air quality commonly lessen ozone harming substance discharges. Alterations to touching practices, for example, executing economical stocking rates, rotational brushing and occasional utilization of rangeland, can prompt ozone harming substance decreases. Changing over minimal cropland to trees or grass augments carbon stockpiling ashore that is less appropriate for crops.

Animal and vegetation
Compost improving nitrogen use efficiency effectiveness through rehearses like accuracy cultivating utilizing GPS following can diminish nitrous oxide discharges and store carbon into soil. Different methodologies incorporate the utilization of cover harvests and excrements (both green and creature); nitrogen-fixing crop revolutions; treating the soil and manure teas; and coordinated nuisance the board.

Different sources of organic material
Over time, the application and incorporation of organic materials can result in an increase in soil organic matter levels. Sources of organic materials include:
- Crop residues.
- Animal manure.
- Compost.
- Cover crops (green manure)
- Perennial grasses and legumes

Role of Soil Organic Matter
There are various advantages to having a somewhat high stable natural matter level in a farming soil. These advantages can be assembled into three categories
- Effect on soil physical properties
- Effect on Chemical properties
- Effect on Biological properties

Effect on soil physical properties
1. Enhances aggregate stability.
2. Improving water infiltration and soil aeration, reducing runoff.
3. Improves water holding capacity.

4. Reduces stickiness of clay soils making them easier to till.
5. Reduces surface crusting, facilitating seedbed preparation.

Effect on Chemical properties

- Increases the soil's CEC or its ability to hold onto and supply over time essential nutrients such as calcium, magnesium and potassium.
- Works on the capacity of a soil to resist pH change; this is also known as buffering capacity.
- Accelerates decomposition of soil minerals over the long run, making the supplements in the minerals accessible for plant take-up.

Effect on Biological properties

1. Provides food for the living organisms in the soil.
2. Enhances soil microbial biodiversity and activity which can help in the suppression of diseases and pests.
3. Enhances pore space through the actions of soil microorganisms. This helps to increase infiltration and reduce runoff.

Different form of organic carbon

Course particulate organic C and fine particulate organic C

Soil sample was passed through a set of 250 and 53 µm sieves. The material retained on the 250 µm sieve consisted of coarse POM (cPOM) and sand (250–2000 µm size). The material retained on the 53 µm sieve comprised fine POM (fPOM).

Light fraction and heavy fraction

The material was allowed to equilibrate for 48 h at room temperature. The suspended material, light fraction organic matter (LFOM). The residual heavy fraction that settled after the removal abeled as heavy fraction organic matter (HFOM).

Mineral associated (Min-OC) organic C

The slurry that went through 53 µm strainer involving sediment and mud particles and mineral related natural matter was centrifuged and the arrangement was tapped. The mineral matter was dried at 50 °C, gauged and named as mineral related natural matter (Min OM).

Soil inorganic carbon

It consists of mineral forms of C, either from weathering of parent material, or from reaction of soil minerals with atmospheric CO_2. Carbonate mineral is soil carbon in desert climates.

Water extractable organic carbon (WEOC)

It was determined by shaking soil with deionised water for on a horizontal shaker Organic carbon in the extracts was determined following the method given by McGill *et al*. (1986).

Hot water soluble carbon (HWC)

It was determined by moderately boiling a mixture of soil and distilled water and the amount of C in the extract was assayed as per the method given by Schulz *et al*. (2003).

Fraction 1 (Very labile): Organic C oxidisable under 12 N H_2SO_4.
Fraction 2(Labile): Difference in oxidisable organic C extracted between 18 N and 12 N H_2SO_4 (18 N-12 N H_2SO_4).
Fraction 3(Less labile): Difference in oxidisable organic C extracted between 24 N and 18 N H_2SO_4.
Fraction 4(Recalcitrant): Residual organic C after reaction with 24 N H_2SO_4 when compared with total organic carbon (TOC-24 N H_2SO_4).

Result

Sofi *et al* 2016 [8] conduct an experiment and find that the soil carbon content was most noteworthy in backwoods soil, while the reception of cereal based editing framework brought about decrease of carbon stocks, consequently featuring the significance of woodland as best oversaw environment. With decrease of carbon stocks in grain based editing frameworks, the accessible pool of supplements was essentially diminished and most minimal substance was recorded in maize-oat trimming framework. Consideration of vegetables in apple plantation floor and maize as intercrop showed fundamentally further developed soil state of being which correspondingly recorded higher soil protein movement. Soil quality appraisal was performed by choosing the markers utilizing head part examination where higher factor stacking was held. Interclass connection was performed to keep away from excess. Scoring of the chose pointers was finished by homothetic change. It was tracked down that the apple-vegetable editing framework recorded the most elevated soil quality rating across the treatment.
Mandal *et al* 2007 [7] find that the long- term intensive rice- based cropping frameworks caused a net consumption of SOC that was conversely corresponding to the measure of buildup C sources of info. Notwithstanding, adjusted preparation (with NPK) further developed the SOC level much under in any case horrible condition (high summer temperature) in this subtropical district. Such build- up was more with the framework having twofold rice harvest or single rice crop with buddy crops like wheat, sesame/mustard, and so on creating lower quality (low N content) of yield buildups. Natural alterations like FYM or fertilizer fundamentally couldn't considerably further develop SOC stock (~10.7%) yet supported the pace of adjustment of harvest buildup C to SOC by about 1.6 occasions more than that in its nonappearance. The sum settled comprised just 18% of the applied C and the rest got lost through oxidation. The framework with twofold rice crop in a year showed momentous proficiency in balancing out more prominent measure of applied C into SOC as contrasted and the other tried cropping systems. Attempts are required to be made to curb the escaping of such a huge amount of C from the cropped soils in order to maintain the soil health and to restrain the global warming.
Benbi *et al* 2012 [1] revelled that the application of organic amendments in rice-wheat system has a major influence on SOC and the relative distribution among various C pools. The LFOC is most sensitive to management, followed by sand-sized HFOC and silt- and clay-sized MinOC pool suggesting thereby that these may be considered to represent active, slow and passive pools of SOC, respectively. The conjoint use of FYM, RS and fertilizer N could maintain SOC almost at the same level as for the uncultivated soil and this practice may help in maintaining the sustainability of rice-wheat cropping systems in the Indo-Gangetic plains.
Srinivasarao *et al*. 2014 [9] carried out an experiment and find that the Sustainable yield index was measured with the integrated use of chemical fertilizer and FYM. However, even the addition of 33.5 $Mgha^{-1}$C inputs through crop residues and FYM resulted in the net depletion of 4.4 MgC ha^{-1} by 18 years of cultivation. Treatment including 50 per cent suggested portion of N provided through synthetic composts and another 50 per cent through FYM decreased the exhaustion of SOC stocks and delivered better returns. Increase in SOC stock by 1Mgin 1-m

depth increased cumulative grain yield by 0.46 Mg ha^{-1}. However, most (77 per cent) of the C supplemented through FYM in this climate was mineralized and only a small fraction (23 per cent) was stabilized into SOC stock. The threshold level of C input to maintain SOC at the antecedent level (with no change), was 3.3 MgC ha^{-1}. However, the antecedent level is low and below the threshold required for a good soil health. Thus, the pace of expansion of natural changes ought to be essentially multiplied to lessen SOC consumption and expanded impressively to upgrade the SOC stock. Strong relationship was observed among the different SOC fractions, of which MBC explained a higher variability in the SYI.

Kalambukattu *et al* 2013 [3] result show that the in this investigation show that different land use and cropping systems in the Almora region of Central Himalaya to evaluate total organic carbon (TOC), microbial biomass carbon (MBC), particulate organic carbon (POC), labile carbon (LC), microbial quotient (MQ) (i.e., ratio of MBC to TOC) and measured the carbon management index (CMI). The TOC content recorded the highest value in undisturbed forest (45.4 g kg_1 soil) and most reduced in infertile (18.4 g kg^{-1} soil). The MBC values varied from 146 mg kg^{-1} in barren land to 783 mg kg_1 in undisturbed oak forest. Land under organic farming showed that higher LC values (4.0 g kg^{-1}) than soya bean wheat and fodder crops. The average POC values ranged from 0.9 gkg_1 in barren land to 11.0 g kg_1 in undisturbed oak forest. Variation of these parameters with season and depth was also observed. The CMI was most elevated under the woodland environment and least in fruitless land. Our investigation subsequently uncovered that development of Himalayan soils has fundamentally diminished the dirt natural carbon pools and in this manner upkeep of normal woods or eco-accommodating practices, for example, consideration of vegetables and use of organics is critically required for economical utilization of these ecosystems.

Srinivasarao *et al* (2014) [10] experiment show that the Microbial biomass carbon (mg kg^{-1}) approximate double as compare to control within 18 years and particulate organic carbon (g kg^{-1}) is high in the applied in both fertilizer and FYM i.e carbon build up (per cent) and carbon build rate (Mg C ha^{-1} y^{-1}) is highest.

References

1. Benbi DK, Brar K, Toor AS, Singh P, Singh H. Soil carbon pools under poplar-based agroforestry, rice-wheat, and maize-wheat cropping systems in semi-arid India. Nutrient Cycling in Agroecosystems. 2012;92(1):107-118.
2. Benbi DK, Toor AS, Kumar S. Management of organic amendments in rice-wheat cropping system determines the pool where carbon is sequestered. Plant and Soil. 2012;360(1-2):145-162.
3. Kalambukattu JG, Singh R, Patra AK, Arunkumar K. Soil carbon pools and carbon management index under different land use systems in the Central Himalayan region. Acta Agriculturae Scandinavica, Section B–Soil and Plant Science. 2013;63(3):200-205.
4. Korkmaz K. Tarm Girdi Sisteminde Azotve Azot Kirlilii, 2007. http://www.ziraat.ktu.edu.tr/tarim_girdi.htm.
5. Kumar M, Puri A. A review of permissible limits of drinking water. Indian Journal of Occupational and Environmental Medicine. 2012;16(1):40.
6. Lal R. Soil carbon sequestration impacts on global climate change and food security. Science. 2004;304(5677):1623-1627.
7. Mandal B, Majumder B, Bandyopadhyay PK, Hazra GC, Gangopadhyay A, Samantaray RN, *et al*. The potential of cropping systems and soil amendments for carbon sequestration in soils under long- term experiments in subtropical India. Global Change Biology. 2007;13(2):357-369.
8. Sofi JA, Bhat AG, Kirmai NA, Wani JA, Lone AH, Ganie MA, *et al*. Soil quality index as affected by different cropping systems in northwestern Himalayas. Environmental Monitoring and Assessment. 2016;188(3):161.
9. Srinivasarao CH, Venkateswarlu B, Lal R, Singh AK, Kundu S, Vittal KPR, *et al*. Long- term manuring and fertilizer effects on depletion of soil organic carbon stocks under pearl millet- cluster bean- castor rotation in Western India. Land Degradation & Development. 2014;25(2):173-183.
10. Srinivasarao C, Lal R, Kundu S, Babu MP, Venkateswarlu B, Singh AK. Soil carbon sequestration in rainfed production systems in the semiarid tropics of India. Science of the Total Environment. 2014;487:587-603.