



Evaluating the Impact of Resource Conservation Practices on Soil Carbon Sequestration in Agriculture

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Carbon sequestration is accumulating atmospheric carbon dioxide, deplete to the soil degradation, augmenting soil fertility, enhancing organic carbon and carbon stocks. Various resource conservation practices involving incorporation of organic manures, cover cropping, zero tillage, mulching, conservation tillage, fertility management, agroforestry, and crop rotation are the enhancing in carbon stocks on agricultural lands. Sequestration of carbon in soil is the importance of that potential is more significant. appropriation of zero tillage bulk density may be enlarge than

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conventional tillage. The soil aggregates disturbance in the surface layers and decline in the amount of total SOC, mainly due to the macroaggregates, occurs under conventionally tilled soil. The SOC response to cover cropping or diverse crop rotation was more observable in medium-textured soils than soils types. mixed cropping systems with conservation tillage sequestered 10% more SOC than conventional tilled crop-fallow systems, rises than SOC sequestration with diverse cropping or conservation tillage. Diversified crop rotation dispenses an opportunity to produce very large biomass C that impact SOC by changing the quantity and the quality of organic matter input more than under mono cropping.

Keywords: Carbon sequestration and potential; carbon stock; resource conservation practice; mulching.

1. INTRODUCTION

Revival of soil health through soil organic carbon management is a significant concern for tropical region soils. The arid region is rate of decomposition is high that causes mineralization process fast resulting in loss of soil organic carbon. Soil organic carbon which controlling following factors Land use pattern, fertility, climatic, biological activity (soil microbiology), vegetation pattern (Jenny and Raychaudhuri 1960).

Carbon sequestration refers to the process of apprehending and storing atmospheric carbon dioxide (CO₂) to mitigate global warming and climate change. There are various types of carbon sequestration they are direct or indirect, and biological, chemical, geological, or physical in nature. the inorganic CO₂ is sequestered directly by plants through photosynthesis. The carbon sequestration is the crucial factor for the sustain soil microbial diversity, enhance the soil fertility, boost the productivity and production. It is maintaining the environments balance of carbon is captured and stored in soil, ocean, ice. Respiration process of the plant carbon dioxide is captured in the photosynthesis metabolism this is natural process. The concentration of atmospheric carbon dioxide increases due to the anthropogenic activity this is cement manufacturing, deforestation, combustion of the fuels, biomass burning etc which responsible to the increasing global warming.

Carbon sequestration potential which is depends on the climatic factors they regulate various process of soil. The arid climate is high

temperature the of decomposition of organic matter high and mineralization process is high due to this process loss of organic carbon is high. The arid climate also less of the carbon stock. The humid and cool region rate of decomposition is negligible also mineralization process is slow that why the carbon stock is high the humid climate.

Potential of the Carbon sink ability also differ due to soil types, land use. The changing of agroecosystem is effect on the Soil organic carbon storage. soil is one of the important terrestrial stock and which two to three time more potential. Soil organic carbon is a center for the soil functioning and determining of the soil capacity to hold and release water and essential nutrients that are importance for the plant growth.

2. CARBON CYCLE

Towards the end of the nineteenth century, where as anthropogenic disturbance of the global C cycle during the twentieth century has been an historically extraordinary phenomenon. The significance of atmospheric concentration of CO₂ on global temperature was understand by Arrhenius.

The data on C pools among major reservoirs are from (Batjes, 1996). Biological processes also help to the absorption of atmospheric CO₂ in the ocean. Phytoplankton photosynthesis lowers the partial pressure of CO₂ in the upper ocean and thereby promotes the absorption of CO₂ from the atmosphere (Falkowski et al., 2000).

Table 1. Estimated potential of carbon sequestration in global croplands

Sr. No	Total estimated C stored in croplands	Estimated annual C sea potential in global croplands	Percentages of initiatives target (3.5 Pg C/yr)	References
1	83 Pg C	0.34 Pg C/yr	10%	Padarian J. et al, 2022
2	135 PgC	0.19 Pg C/yr	5.4 -32%	Lal et al, (2008)

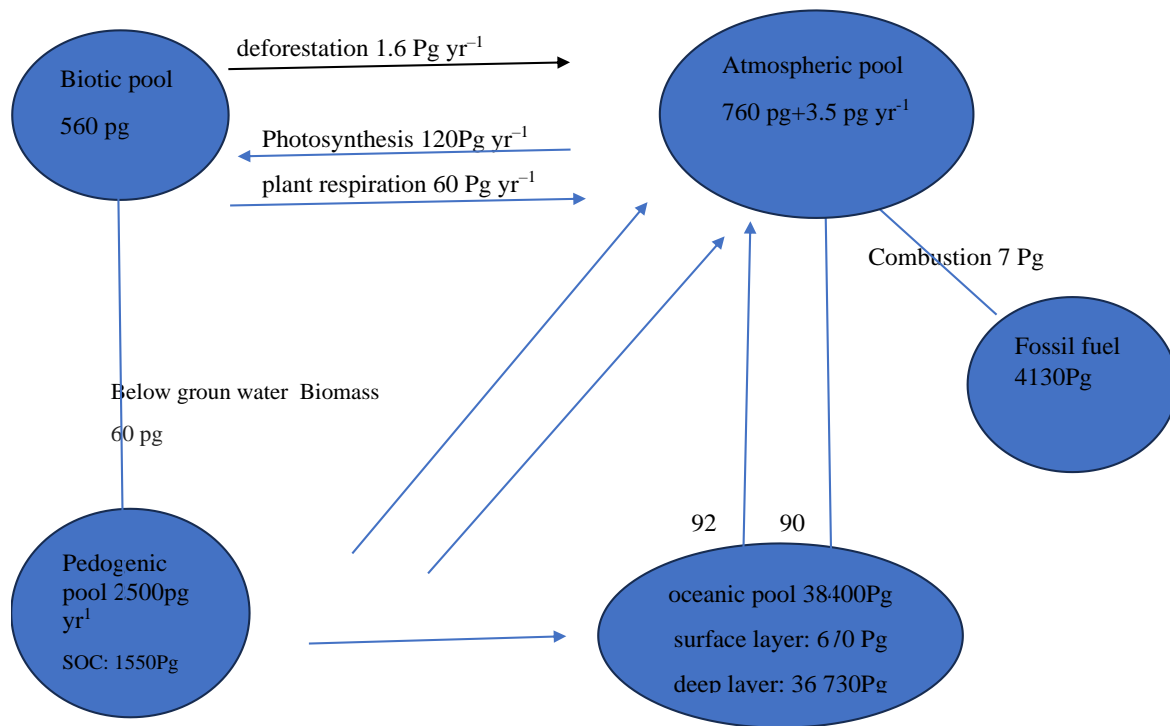


Fig. 1. Principal global C pools and fluxes
(Source Batjes, N. H., 1996)

Understanding the global C cycle and its disruption by anthropogenic activities is important for developing applicable strategies for mitigating climate change. The rate of future increase in atmospheric CO₂ concentration will depend on the anthropogenic activities, the biogeochemical interaction of climate processes on the global C cycle and interaction among between principal C pools. show reserves of fossil fuel include 678 Pg of coal. Addition of crop residue as the source of compost or biochar can increase the soil C stock, it result may reduce emission of CO₂ from atmosphere (Padarian et al., 2022).

3. SOIL CARBON SEQUESTRATION POTENTIAL

“Carbon sequestration potential which is depends on the climatic factors they regulate various process of soil. Soil itself capable to maintain the atmospheric balance gain and loss of carbon dioxide emission. The ability of a soil system to sequester C lies in the balance between net gains and net losses. The industrial revolution increases in Carbon emissions the global C cycle, or C flux was maintained at a near balance between uptake of CO₂ (sinks) and

its release back into the atmosphere (sources). Soil organic carbon can be characterized as a dynamic equilibrium between gains and losses. Practices that either increase inputs or reduce losses can promote soil C sequestration.

The photosynthesis catch atmospheric carbon is gain the soil carbon is called net primary productivity. The agriculture land use change is increasing continuously atmospheric carbon dioxide. Global greenhouse gas 24% emissions accounting by TSU, I. S. IPCC AR5 Synthesis Report (2014). Carbon management is practices soil act as both the sources and sinks reforestation (replanting trees in deforested areas) and afforestation (planting trees in areas that were previously non-forested). Significantly more carbon is stock in the world’s soils than is present in the atmosphere. The global soil carbon pool to 1 m depth, estimated at 2500 Pg C of which about 1500. The global soil carbon pool to 1 m depth, estimated at 2500 Pg C of which about 1500 Pg C is soil organic is about 3.2 times the size of the atmospheric pool and 4 times that of biotic pool (Lal, 2010). Resource conservation practices which is increasing soil organic stocks this practices are organic manure,

cover cropping, rotational grazing, agroforestry, mulching, conservation tillage, fertility management, (Padarian et al., 2022). Increasing global warming is increasing earth temperature above 1.5C (Baker et al., 2018). Weather patterns may affect terrestrial C storage changing due to the global warming.

“The net primary production soil C decomposition and C inputs to the soils rates are significantly affected by the change in precipitation, temperature, and CO₂ concentration. Changing climatic patterns may also accelerate land-use change and alters the terrestrial C fluxes” (Kopittke et al., 2019). “Soil C sequestration is also necessary for improving resource use efficiency and increasing soil nutrition status of crop plants to ensure better growth and productivity in a sustainable agriculture. Through denaturation and filtration of pollutants soil C sequestration also helps to enhances biodiversity by protecting land for nature conservancy and improve soil water status. Lack of an accurate estimation of soil C sequestration and including special heterogeneity of SOC, inherent soil variability, hinder the identification of suitable management practices” (Srinivasarao et al., 2020)

“Estimates of soil organic carbon and inorganic carbon pools in world soils given” by Eswaran et al. (1995). Studied that the inorganic carbon was found more in arid and semi-arid regions in aridisols which is approximately 1044 tons per hacter aridisols are soils. The organic carbon was found more in Histosols. Table 2 shows Histosols are soils which contain organic carbon percentage more as compared to other soil orders. the content of organic carbon and inorganic carbon content in world soil given in tons per hacter.

Forms of conservation agriculture

Major forms of conservation agriculture includes

- Minimum, reduced or no tillage
- Crop and pasture rotation
- Contour farming and strip cropping
- Cover and green manure cropping
- Fertility management
- Erosion control
- Agro-forestry and alley cropping
- Organic and biodynamic farming
- Stubble mulching
- Integrated nutrient management (INM) Patle et al, (2013)

Table 2. Carbon pool depth in soil orders

Soils	Carbon pool to 1-m depth	
	Organic	Inorganic
Ultisols	101	0
Andisols	69	1
Aridisols	110	1044
Oxisols	150	0
Inceptisols	267	258
Alfisols	136	127
Mollisols	72	139
Vertisols	38	25
Spodosols	98	0
Entisols	106	117
Histosols	390	0
Miscellaneous	18	0
Total	1555	17

(Eswaran et al., 1995)

4. RELATION SOIL ORGANIC CARBON IN TO THE SOM

Soil organic matter consists of complex organic substances, including humic substances, organic crop residues and microbial bodies that decompose at various stages. It affects plant growth and a reservoir for plant nutrients, yield by enhancing soil structure and serving as containing 2.5 exagrams (Eg) of carbon (1 Eg = 10¹⁸ g). The formation of clay-humus complexes improves soil buffering capacity and creates stable complexes with certain metals, making them more available for plant uptake. Soil carbon is primarily originate in the form of organic matter or humus. Soil organic carbon (SOC) content ranges from 1% in coarse-textured soils to 3.5% in grasslands. Tropical, subtropical, arid, and semi-arid climates soils low SOC levels, as well as practices like frequent tillage, excessive use of agrochemicals like (fertilizers, pesticides, fungicides,) and removal of crop residues. Soil organic matter (SOM) can be categorized into different pools based on the time required for complete decomposition and the turnover time of these products in the soil. Soil is contribute the global carbon cycle and hold more carbon as compare to other pool. Soil is use for cultivations of food production cause 30-60 % loss of carbon, causing decline soil productivity (Kopittke et al., 2019)

5. CONSERVATION AGRICULTURE

Conservation Agriculture is crucial practice of agriculture which maintain the environment and

ecological balance. It helps to boost productivity and production. Soil organic carbon (SOC) concentration increase due incorporating of the crop cover to the soil. Diversified crop rotation also helps to increase the SOC. Legume-based systems, in particular, contribute higher amounts of aromatic carbon, maintaining optimal C:N ratios and thereby boosting productivity. The SOC was increased by 72% with a CA-based maize-wheat-mung bean system and 83% with the rice-wheat mung bean system compared to conventional RW system (Parihar et al., 2018). "Conservation agriculture significantly increased SOC content in both 0–15 cm and 15–30 cm depth compared with CT in the maize-based cropping system" (Parihar et al., 2018, Parihar et al., 2020) (Table 3).

Following Principle of conservation agriculture can be described by FAO.

1. 1.No tillage or Minimal soil disturbance: The disturbed area must be no wider than 15 cm or 25% of the cropped area, whichever is smaller. Periodic tillage should not exceed these limits.
2. Soil cover residue: Ground cover must exceed 30%. Which reduce soil loss by degradation.
3. Crop Diversification: Rotation should involve at least three different crops. Avoid the monocropping

Soil organic carbon influences various factors which are types of soil, Tillage operation practices, topography in slopes, application of fertilizers, land use as essential factors. variability of soil organic carbon. Tillage operation is regulate the soil structure and also help to storage of soil carbon stock (Abdalla et al., 2013). The soil colloids availability Important factor of carbon sequestration (Naitam and Bhattacharyya, 2004) because the rate of carbon sequestration is high in clay soil. Appropriate sustainable management practices, such as suitable crop rotations, balanced nutrient management, and conservation tillage mulching,

cover cropping, can help overcome challenges related with soil carbon sequestration (Nath et al., 2017). Conserving soil fertility sustainably is importance of improve soil physical, chemical and biological properties of the soils. Which reduce soil erosion, better the soil structure, improve water holding capacity, cation exchange capacity, buffering capacity, and microbial populations. which helps to maintain the soil carbon stocks.

Conservation agriculture helps is improving the soil properties while positively influencing climate change mitigation (Kassam et al., 2019). Conservation practices helps to minimizes soil compaction, weed infestation, reduce the cost of cultivation, minimize the greenhouse gases (Giller et al., 2009) and (Hobbs et al., 2008). Zero tillage is keeping of crop residues on the surface of the top soil which minimize the soil degradation, boosting soil fertility, and improving soil organic matter sequestration which helps to mitigates global warming (Wang et al., 2020, Kassam et al., 2019). The agriculture, deforestations and land use emission of CO₂ is Contributes 50%, and 22.9% of total CO₂ emissions to the atmosphere (IPCC, 1996) Intergovernmental Panel on Climate Change, 1996.Agriculture is accountable for 30%Of emission of total GHG of CO₂ NO₂ and CH₄ (IPCC, 2014) which affected by climate change. Various reports have revealed that No tillage and crop residue management improves soil Aggregation and increases SOC Content (Havlin et al., 1990, Carter, 1992, Cambardella and Elliot, 1994).

Application of Nitrogenous fertilizers is help to increase SOC and Yield of crop (Varvel, 2006). The technique of potential of GHG mitigation (Snyder et al., 2009). Conservation agriculture is a foundations for the Sustainable agricultural Production intensification (Kassam et al., 2009, Friedrich et al., 2012, Jat et al., 2014, Farooq and Siddique, 2014). Improvement of soil organic carbon with minimize global warming and secure the food security (Lal, 2004).

Table 3. Effect of zero tillage and conservation tillage on SOC Stock

Sr. No.	Treatment	Soil organic carbon (g kg ⁻¹)		Total soil organic C stock (t ha ⁻¹)		Change in total SOC stock (t ha ⁻¹)
		0–15 cm	15–30 cm	0–15 cm	15–30 cm	
1	ZT	6.23	5.23	14.8	13.4	7.7 2
2	CT	4.73	4.33	11.2	10.7	0.88

(Parihar et al., 2020)

Table 4. Soil Aggregate Stability and Aggregate Associated Carbon Under Different Tillage

Soil depth (cm)	Soil organic C concentration (g kg ⁻¹)			
	MP-R	MP+R	RT	NT
0-5	10.26±0.19	11.35±0.42	13.59±0.18	14.33±0.62
5-10	10.84±0.30	10.83±0.34	13.57±0.05	12.31±0.48
10-20	10.41±0.26	10.72±0.38	9.7±0.17	9.03±0.42
20-30	7.46±0.12	7.84±0.07	7.15±0.14	7.09±0.42

MP-R moldboard plough without residue; MP+R moldboard plough with residue; RT, rotary tillage with residue; NT, no tillage with residue; Zhang-liul et.al (2013)

Conservation agriculture is help to mitigate climate change by reduce the GHG emission of (carbon dioxide, nitrous oxide, and methane) (Parihar et al., 2016). Rise of Soil organic matter enhance the water holding capacity and sustain the crop in drought conditions of the crops (Bhattacharya et al., 2020)

Conservation tillage practices no tillage with residue is increased SOC Content in the depth of 0-5 cm (Zhang et al., 2013) Table 4.

Several anthropogenic activities also contribute to soil carbon losses, including:

1. Deforestation
2. Soil erosion
3. Excessive ploughing
4. Burning of crop residues
5. Summer fallow
6. Bare soil during the winter season
7. Monocropping
8. Inefficient recycling of elements
9. Nutrient depletion
10. Water deficiency
11. Low-input subsistence farming and soil fertility mining
12. Intensive cropping and cultivating marginal soils (Chatterjee et al., 2020).

Soil organic matter low in Arid, semiarid and subhumid climate is the crucial factor contributing to the productivity (Syers et al., 1996). Zero tillage is effect majorly depends upon the the quantity and quality of crop residue return to the field (DeMoraes and Lal, 2009). crop residues are removed from the field after harvest of the crop so they do not provide the mulch cover wanted for CA. crop harvest . Decline of the soil organic matter due to the land is converted forest or grassland to agriculture is rapid 50% of SOM loss within 10-15 years (Diels et al., 2004, Zingore et al., 2007). Conservation agriculture is help to enhance soil biological properties like soil biota because increase soil microbial population (Hobbs et al., 2008).CA is lower the rate mineralization mean the nutrient present on the soil for long period. It help also reduce nutrient

loss and increase the nutrient use efficiency. Soil organic carbon has interaction with the tillage and N fertilizer in the 0 – 10 cm layer(Mazzoncini et al., 2011). SOC is provide the food of soil microorganism that crucial role in mineralization of the nutrient in nutrient cycles. Soil structure can improve the tillage it is the crucial factor of storage of the soil organic carbon and reduce GHG emissions (Abdalla et al., 2013).

6. CONCLUSION

Carbon sequestration on agricultural lands can be achieved through various soil management strategies, potentially leading to significant benefits if implemented widely. These practices help maintain atmospheric carbon balance by reducing greenhouse gases and increasing atmospheric carbon dioxide. Certain agricultural management practices show promise for restoring soils and sequestering a substantial portion of atmospheric carbon. Additionally, carbon sequestration contributes to reduced soil degradation, enhanced soil nutrients and health, improved water quality, better wildlife habitat, and economic benefits for farms.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Abdalla, M., Osborne, B., Lanigan, G., Forristal, D., Williams, M., Smith, P., Jones, M. B. (2013). Conservation tillage systems: A review of its consequences for greenhouse gas emissions. *Soil Use Manag.*, 29, 199–209.

- Abdalla, M., Osborne, B., Lanigan, G., Forristal, D., Williams, M., Smith, P., Jones, M. B. (2013). Conservation tillage systems: a review of its consequences for greenhouse gas emissions. *Soil Use and Management*, 29, 199–209.
- Baker, H. S., Millar, R. J., Karoly, D. J., Beyerle, U., Guillod, B. P., Mitchell, D., Shiogama, H., Sparrow, S., Woollings, T., Allen, M. R. (2018). Higher CO₂ concentrations increase extreme event risk in a 1.5 °C world. *Nat. Clim. Chang.*, 8, 604–608.
- Batjes, N. H. (1996). Total carbon and nitrogen in the soils of the world. *European Journal of Soil Science*, 47, 151–163.
- Bhattacharya, P., Maitry, P. P., Mowrer, J., Maitry, A., Ray, M., Das, S., Chakrabarti, B., Ghosh, T. T., & Krishnan, P. (2020). Assessment of soil health parameters and applications of sustainability index to fields under conservation agriculture for 3, 6, and 9 years in India. *Heliyon*, 6(2), e05640.
- Cambardella, C. A., & Elliot, E. T. (1994). Carbon and nitrogen dynamics of soil organic matter fractions from cultivated grassland soils. *Soil Sci. Soc. Am. J.*, 58, 123–130.
- Carter, M. R. (1992). Influence of reduced tillage systems on organic matter, microbial biomass, macro-aggregate distribution and structural stability of the surface soil in humid climate. *Soil Tillage Res.*, 23, 361–372.
- DeMoraes Sá, J. C., & Lal, R. (2009). Stratification ratio of soil organic matter pools as an indicator of carbon sequestration in a tillage chronosequence on a Brazilian Oxisol. *Soil and Tillage Research*, 103, 46–56.
- Diels, J., Vanlauwe, B., Van der Meersch, M. K., Sanginga, N., & Merckx, R. (2004). Long term soil organic carbon dynamics in a subhumid tropical climate: C-13 data in mixed C3/C4 cropping and modeling with RothC. *Soil Biology and Biochemistry*, 36, 1739–1750.
- Eswaran, H., Vandenberg, E., Reich, P. (1995). Organic carbon in soils of the world. *Soil Science Society of America Journal*, 57, 192–194.
- Falkowski, P., Scholes, R. J., Boyle, E., Canadell, J., Canfield, D. (2000). The global C cycle: The test of our knowledge of earth as a system. *Science*, 289, 270–277.
- Farooq, M., & Siddique, K. H. M. (Eds.). (2014). *Conservation agriculture*. Springer International, Switzerland.
- Friedrich, T., Derpsch, R., & Kassam, A. H. (2012). Overview of the global spread of Conservation Agriculture. *Field Actions Science Reports*, Special Issue 6, 1–7.
- Giller, K. E., Witter, E., Corbeels, M., Tittonell, P. (2009). Conservation agriculture and smallholder farming in Africa: The heretics' view. *Field Crop. Res.*, 114, 23–34.
- Havlin, J. L., Kissel, D. E., Maddux, L. E., Claassen, M. M., & Long, J. H. (1990). Crop rotation and tillage effects on soil organic carbon and nitrogen. *Soil Sci. Soc. Am. J.*, 54, 448–452.
- Hobbs, P. R., Sayre, K., & Gupta, R. (2008). The role of conservation agriculture in sustainable agriculture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363(1491), 543–555. <https://doi.org/10.1098/rstb.2007.2169>
- Hobbs, P. R., Sayre, K., & Gupta, R. (2008). The role of conservation agriculture in sustainable agriculture. *Philosophical Transactions of the Royal Society B*, 363, 543–555.
- Intergovernmental Panel on Climate Change (IPCC). (1996). *Climate change 1995. Working Group 1*. IPCC, Cambridge University Press, Cambridge, UK.
- IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.
- Jat, R. A., Sahrawat, K. L., & Kassam, A. H. (Eds.). (2014). *Conservation agriculture: Global prospects and challenges*. CABI, Wallingford. 393 pp.
- Kassam, A. H., Friedrich, T., Derpsch, R. (2019). Global spread of conservation agriculture. *Int. J. Environ. Stud.*, 76, 29–51.
- Kassam, A. H., Friedrich, T., Shaxson, F., Pretty, J. (2009). The spread of Conservation Agriculture: Justification, sustainability and uptake. *International Journal of Agricultural Sustainability*, 7(4), 1–29.
- Katyal, J. C., Rao, N. H., & Reddy, M. N. (2001). Critical aspects of organic matter management in the tropics: The example of India. *Nutrient Cycling in Agroecosystems*, 61, 77–88.
- Kopittke, P. M., Menzies, N. W., Wang, P., McKenna, B. A., & Lombi, E. (2019). Soil and the intensification of agriculture for global food security. *Environment International*, 132, 105078.

- Kumar, R., Mishra, J. S., Rao, K. K., Mondal, S., Hazra, K. K., Choudhary, J. S., & Bhatt, B. P. (2020). Crop rotation and tillage management options for sustainable intensification of rice-fallow agro-ecosystem in eastern India. *Scientific Reports*, 10(1), 1–15.
- Lal, R. (2004). Soil carbon sequestration impact on global climate change and food security. *Science*, 304, 1623–1627.
- Lal, R. (2010). Managing soils and ecosystems for mitigating anthropogenic carbon emissions and advancing global food security. *BioScience*, 60, 708–721.
- Mazzoncini, M., Sapkota, T. B., Barberi, P., Antichi, D., & Risaliti, R. (2011). Long-term effect of tillage, nitrogen fertilization and cover crops on soil organic carbon and total nitrogen content. *Soil and Tillage Research*, 114(2), 165–174.
- Naitam, R., & Bhattacharyya, T. (2004). Quasi-equilibrium of organic carbon in shrink–swell soils of the subhumid tropics in India under forest, horticulture, and agricultural systems. *Soil Res.*, 42, 181–188.
- Nath, C., Das, T., Rana, K., Bhattacharyya, R., Pathak, H., Paul, S., Meena, M., Singh, S. (2017). Weed and nitrogen management effects on weed infestation and crop productivity of wheat–mungbean sequence in conventional and conservation tillage practices. *Agric. Res.*, 6, 33–46.
- Padarian, J., Minasny, B., McBratney, A., & Smith, P. (2022). Soil carbon sequestration potential in global croplands. *PeerJ*, 10, e13740.
<https://doi.org/10.7717/peerj.13740>
- Parihar, C. M., Prihar, M. D., Sapkota, T. B., Nanwal, R. K., Singh, A. K., Jat, S. L., et al. (2018). Long-term impact of conservation agriculture and diversified maize nitrogen fractions and nitrous oxide fluxes in inceptisol of India. *Science of the Total Environment*, 640, 1382–1392.
- Parihar, C. M., Singh, A. K., Jat, S. L., Dey, A., Nayak, H. S., Mandal, B. N., Saharawat, Y. S., Jat, M. L., & Yadav, O. P. (2020). Soil quality and carbon sequestration under conservation agriculture with balanced nutrition in intensive cereal-based system. *Soil and Tillage Research*, 202, 104653.
- Parihar, C. M., Yadav, M. R., Jat, S. L., Singh, A. K., Kumar, B., Pradhan, S., Chakraborty, D., Jat, M. L., Jat, R. K., Saharawat, Y. S., & Yadav, O. P. (2016). Long term effect of conservation agriculture in maize rotations on total organic carbon, physical and biological properties of a sandy loam soil in north-western Indo-Gangetic Plains. *Soil and Tillage Research*, 161, 116–128.
- Snyder, C. S., Bruulsema, T. W., Jensen, T. L., & Fixen, P. E. (2009). Review of greenhouse gas emissions from crop production systems and fertilizer management effects. *Agriculture, Ecosystems & Environment*, 133(3–4), 247–266.
- Syers, J. K., Lingard, J., Pieri, J., & Ezcurra, G. (1996). Sustainable land management for the semiarid and sub-humid tropics. *Ambio*, 25, 484–491.
- Varvel, G. E. (2006). Soil organic carbon changes in diversified rotations of the western corn belt. *Soil Science Society of America Journal*, 70(2), 426–433.
- Wang, H., Wang, S., Yu, Q., Zhang, Y., Wang, R., Li, J., Wang, X. (2020). No tillage increases soil organic carbon storage and decreases carbon dioxide emission in the crop residue-returned farming system. *J. Environ. Manag.*, 261, 110261.
- Zingore, S., Murwira, H. K., Delve, R. J., & Giller, K. E. (2007). Influence of nutrient management strategies on variability of soil fertility, crop yields and nutrient balances on smallholder farms in Zimbabwe. *Agriculture, Ecosystems & Environment*, 119, 112–126.

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