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Editorial: Greenhouse Gas Emissions and Terrestrial Ecosystems

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Editorial on the Research Topic

Greenhouse Gas Emissions and Terrestrial Ecosystems

In recent decades, greenhouse gas (GHG, particularly CO_2 and CH_4) emissions are mainly responsible for the increase in global mean temperature due to natural and anthropogenic activities (Hui et al., 2021; Kumar et al., 2021). Grossi et al. (2021) proposed a holistic methodological approach to estimate (quantitatively and qualitatively) the annual GHG emissions and removals occurring in the natural parks and suggest their significance in mitigation of climate change and respective adaptation. In general, the alarming rate of climate change and global warming is critically governed by the rapid increase in urbanization, industrialization, fossil fuel burning, forest fire, change in land use and land cover (LULC; responsible for 10–12% of anthropogenic GHG emissions), agricultural activities in the catchment, slash and burn activities, etc. (Kumar et al., 2021a). LULC change is estimated to emit 1.3 ± 0.5 peta-grams C y^{-1} (~8% of annual emission). Sahoo et al. (2021) worked in the northeastern region of Indian forest and estimated biomass and carbon (C) storage potential under diverse land uses. He found a strong relationship between the biomass C storage and tree basal area. The mean vegetation C stock followed a pattern of temperate forests > subtropical plantations > subtropical forests > tropical forests > tropical plantations > temperate plantations and is useful for the C reduction strategies. Furthermore, accurate quantification of total C stock (forest biomass and soil) is a decisive commission in decision support related to climate and land use management. Nielsen et al. (2021) highlighted the importance of root: shoot (R/S) ratios in imprecise modeling evaluations of the soil C input. An increase in the number of annual cuts was found to lower the R/S (Nielsen et al., 2021). Thakur et al. (2021) worked on a protected area of dry tropical forest and estimated the mean value of net primary productivity (NPP) as 8.74 Mg ha^{-1} yr^{-1} (varied from 7.61 to 9.94 Mg ha^{-1} yr^{-1}) where above-ground biomass contributes 1/3rd of total NPP and further plays an important role in carbon (C) mitigation in central India. In general, tropical ecosystems are hot spots of GHG emissions compared to temperate ones because of higher temperatures and low humidity.

The change in soil C stock under conservation agriculture practices in the Indo-Gangetic Plains and sub-Saharan Africa compared to conventional practice ranged from 0.16 to 0.49 Mg C ha^{-1} yr^{-1} and 0.28 to 0.96 Mg C ha^{-1} yr^{-1}, respectively. These wide ranges energized the young scientists to explore in detail their ecological footprint, energy, and economic effectiveness. Moreover, the significant amount of methane (CH_4) from rice fields, peat lands, bogs, etc.; nitrous oxide (N_2O) from agricultural crops and forest floor; and CO_2 from plants and animals through respiration; soil respiration (efflux of CO_2) and sinks into the terrestrial ecosystems and in the form of crop production, the transportation and production of forest biomass, and agricultural activities also contributes to atmospheric GHG emissions (**Figure 1**). Kumar et al. (2021b) concluded that extensive inter-culture operations (i.e., sowing, irrigation, tillage, fertilizer application, and pest control management) extensively influence the GHG emissions (CO_2 and N_2O) from wheat–maize agricultural soil. However, O'Neill et al. (2021) concluded that management practices, especially row spacing width (125 and 750 mm) and variety of crops, have no consistent effect on

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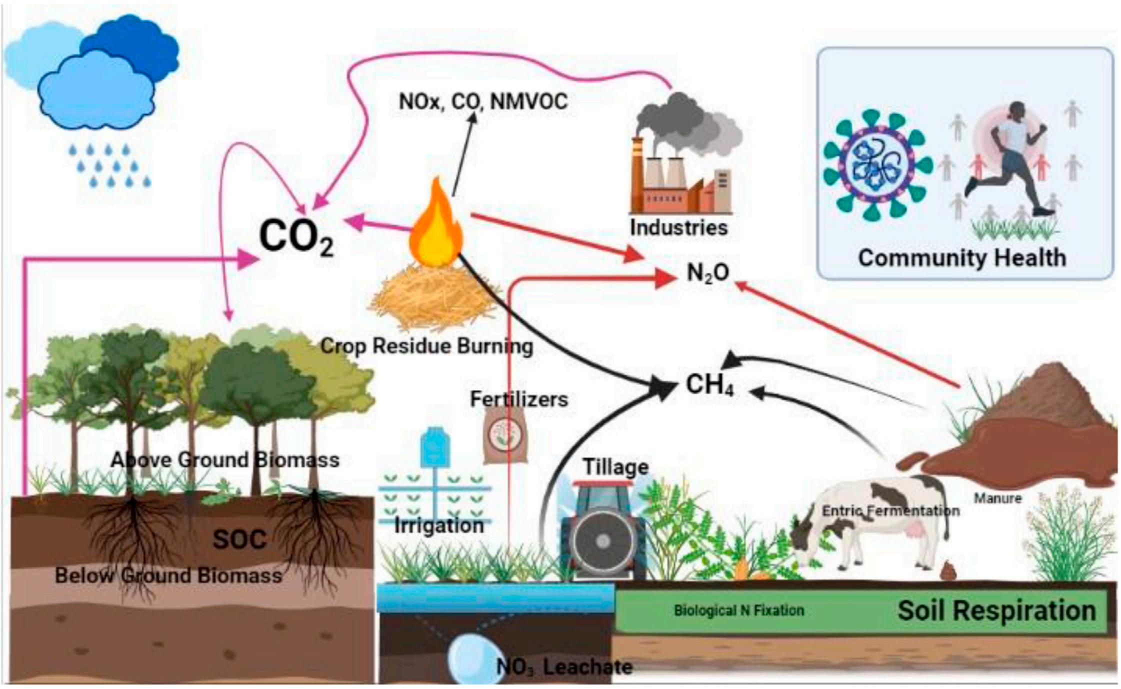

FIGURE 1 | Process, mechanism, and factors affecting carbon dynamics in terrestrial ecosystem.

soil emissions, and modifications in seed yield per plant countered differences in planting density in winter oilseed rape crop grown in Ireland.

The rapid climate change results in loss of terrestrial biodiversity and affects the C dynamics (source and/or sink) both directly and indirectly (Heimann and Reichstein, 2008; Liu et al., 2018). Mohsin et al. (2021) emphasize that a catchment area treatment planning in advance can be helpful in carbon reduction and further enhance the quality of the environment. Nowadays, sector-specific mitigation strategies play an important role in terrestrial GHG trade-offs. In recent decades, management practices, such as catchment area treatment plan, afforestation of plants having high carbon sequestration potential, forest protection (e.g., forest fire), agriculture conservation, zero tillage practices, and incorporation of waste residue could help in increasing C sink or mitigation of the C emission significantly from the terrestrial ecosystems. The rate of C sequestration and forest protection ranges from 0.04 to 7. 52 t C·hm^{-2}·a^{-1} and 0.33 to 5.20 t C·hm^{-2}·a^{-1}, respectively. Based on the comprehensive use of natural resources, Tian et al. (2021) suggested that the necessity and possibility of C trading and redistribution of the natural resources are highly recommended ways to ensure carbon reduction by 2060.

Forest vegetation and perennial crops have high C density (above- and below-ground biomass; ABG and BGB) and tree species richness to support ecosystem resilience to future climate change, besides a strong potential to support forest biodiversity and agricultural productivity (Sharma et al., 2021). Missing the Paris agreement target to achieve global mean temperature (i.e., 2°C) could destabilize Earth's climate, terrestrial ecosystems with terrible consequences for ecosystem services, biodiversity, and humans. Therefore, a strategic management plan is urgently needed to reduce the potential of C by implementing climate change mitigation and adaptation measures in terrestrial ecosystems.

All the guest editors hope that the article (review/research) published in this special issue will help the policy makers, environmentalists, foresters, and young researchers to understand the carbon dynamics in the terrestrial ecosystem at the regional and/or global scale. Furthermore, the mitigation strategies suggested by the different authors will help in C reduction in the terrestrial ecosystem.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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