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EDITORIAL

HIGHLIGHTS OF THE SPECIAL ISSUE "CARBON NEUTRALITY AND A LOW CARBON ECONOMY FOR AGRICULTURE"

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Carbon neutrality and a low carbon economy have become key global objectives and one of China's national policies. In response to global climate change and the Paris Agreement that defines a climate warming target of an increase of 1.5–2.0 °C by the end of century, over 100 countries have made commitments to achieve carbon neutrality-related emissions. Agricultural ecosystems are crucial for climate change mitigation. This special issue summarizes recent progress in agricultural research for achieving carbon neutrality and a low carbon economy, comprising 10 review and research articles from crop and livestock production to food systems, distinguishing four topics related to (1) greenhouse gas (GHG) emissions from agriculture (field crop, horticultural and livestock production) and/or entire food systems, and the technological potential and pathways for mitigating GHG emissions (2 articles), (2) carbon sequestration in plants and soils (3 articles), (3) design, principles, approaches and the implementation of low carbon farming (3 articles), and (4) policy, technical standards and monitoring systems for achieving carbon neutrality (2 articles).

Considering GHG emissions from agriculture (field crop, horticultural and livestock production) and/or entire food systems, Wang et al. (https://doi.org/10.15302/J-FASE-2022477) focused on ammonia, nitrous oxide and nitric oxide emissions, and emission factors in orchards, vegetable fields and tea plantations (OVT). They found that direct emissions of NH_3, N_2O and NO from OVT systems are equivalent to approximately a quarter, two thirds and a half of total farmland emissions in China, respectively. Adding a carbon extension to the NUFER model (a nutrient flow model), Jin et al. (https://doi.org/10.15302/J-FASE-2023494) investigated the spatiotemporal characteristics of GHG emissions from China's food production, showing that agricultural activities and their energy consumption have been the greatest contributor to increased GHG emissions, which can be reduced by enhancing endpoint mitigation technologies, transforming socioeconomic and dietary conditions, and increasing agricultural productivity.

Focusing on carbon sequestration in plants and soils, Essich et al. (https://doi.org/10.15302/J-FASE-2023485) measured the organic carbon stocks in a silty textured soil following the return of a 20-year-old perennial *Miscanthus* × *giganteus* crop to annual cropping. Zhou et al. (https://doi.org/10.15302/J-FASE-2023498) evaluated management effects on proportions of microbial necromass carbon in soil organic carbon (SOC) in various fractions of soil aggregates. They argue that the interactions between microbial byproducts and soil structure drive physical carbon stabilization under cropland management. Wu (https://doi.org/10.15302/J-FASE-2022474) reviewed management strategies for sequestering SOC through land use change and agricultural practices such as afforestation and reforestation, adding organic matter and reseeding grasses to improve livestock grazing management.

In terms of design, principles, approaches and implementation techniques for low carbon farming, Zhu et al. (https://doi.org/10.15302/J-FASE-2023486) investigated the characteristics of GHG emissions from animal husbandry from 1994–2014 and propose ways to achieve the environmentally-sustainable and low-carbon development of animal husbandry. They argue that the enhancement of monitoring and evaluation, and the establishment of emission reduction and carbon sequestration standards is vital if livestock production is to achieve carbon neutrality. Li et al. (https://doi.org/10.15302/J-FASE-2022468) propose an innovation reform model for the mineral nitrogen fertilizer industry in China to reduce GHG emissions for low carbon farming. They found that the production and land application of a mix of newly emerging advanced fertilizers, liquid fertilizers and the reduction of fertilizer applications can reduce GHG emissions, which can be further decreased by upgrading mineral N fertilizer production technology. Reijneveld et al. (https://doi.org/10.15302/J-FASE-2023499) propose a tool consisting of multi-constituent soil analyses and an SOC mineralization model, for rapidly guiding and monitoring soil carbon sequestration in farmer's fields. This is essential for monitoring the progress of SOC sequestration for low carbon farming.

For policy, technical standards and monitoring systems to achieve carbon neutrality, Yin et al. (https://doi.org/10.15302/J-FASE-2023496) propose new pathways for green agricultural development in China against the background of a double-carbon strategy from the perspectives of technology, policy and operational mechanisms. Buckingham et al. (https://doi.org/10.15302/J-FASE-2023495) summarized the priorities for mitigating GHG and NH_3 emissions to meet UK policy targets through a survey for agricultural scientists. This special edition shows that carbon neutrality and a low carbon economy are achievable, but only if techniques for reducing GHG emissions and sequestering carbon can be developed and effectively applied in all types of food production, together with the necessary socioeconomic changes in diet and health.

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