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Climate conditions control the SOC sequestration potential of agricultural terraces

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Agricultural terraces, being among the volumetrically largest and most common man-made landforms, have been widely implemented to support essential soil ecosystem services, e.g., erosion control, soil nutrient, and water retention, and have had an essential impact on soil organic carbon (SOC) stock and its exchange with the atmospheric C. However, the direction and magnitude of this impact remain highly uncertain. By integrating the broad-scale field observations of 14 terrace sites across the EU with a global data synthesis, we demonstrate that the effectiveness of terracing-driven SOC sequestration potential is intricately controlled by climate conditions that govern in-return soil properties.

Our findings reveal that the terracing practices represent a promising land management strategy for enhancing SOC sequestration, but also that risks of SOC loss exist when building terraces under arid climate, where they could be potentially very beneficial to crop productivity and SOC storage. We recommend that future terrace construction should integrate water and nutrient recycling techniques to ensure soil moisture and nutrient availability, enhancing land productivity and maximizing SOC sequestration potential. Our data suggest that promoting the recovery of the lost topsoil C during terrace construction through increasing C inputs and C use efficiency, i.e., straw return and nutrient amendment is an efficient way to counteract initial SOC losses.