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## Suitability of soil carbon certificates for climate change mitigation

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There is growing awareness of the role that agricultural soils can play for climate change mitigation. Agricultural management that increases soil organic carbon (SOC) stocks constitutes a nature-based solution for carbon dioxide removal. As soils store about twice the amount of carbon found in the atmosphere, even small relative increases could significantly reduce global warming.

However, increasing SOC requires management changes that come with costs to the farmers. In this regard, soil carbon certificates could provide a much-needed financial incentive: Farmers register their fields with commercial providers who certify any SOC increase achieved during a set period of time. The certificates are then sold on the voluntary carbon-offset market. We analysed the suitability of soil carbon certificates for climate change mitigation from the perspectives of soil sciences, agricultural management, and governance. In particular, we addressed questions of quantification, additionality, permanence, changes in emissions, leakage effects, transparency, legitimacy and accountability, as well as synergies and trade-offs with other societal targets.

Soil properties and the mechanisms by which carbon is stored in soils have strong implications for the assessment. Soils have a limited storage capacity, and SOC is not sequestered but its SOC stocks are the dynamic result of plant derived inputs and losses mainly in the form of microbial respiration. The higher the SOC stock, the higher the annual carbon inputs that is needed to maintain it. If carbon friendly management is discontinued, elevated SOC levels will therefore revert to their original level.

We found that while changes in agricultural management that increase SOC are highly desirable and offer multiple-co benefits with climate change adaptation, soil carbon certificates are unsuitable as a tool. They are unlikely to deliver the climate change mitigation they promise as certificate providers cannot guarantee permanence and additionality of SOC storage over climate relevant time-frames. Where the certified carbon storage is non-permanent or fails to meet

criteria of additionality, the use of such certificates to advertise products as “carbon-neutral” may be construed as false advertising.