Saving the climate from the ground up

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Increased carbon inputs into the soil could slow down climate change and at the same time increase crop yields, the international research team emphasizes. Credit: Frank Luerweg/University of Bonn

Soil has the capacity to bind large quantities of carbon in the long term.

An international team of researchers, including from the University of Bonn, is now advocating effective use of this potential. Experts estimate that this could reduce currently rising rates of greenhouse gas carbon dioxide in the atmosphere by a third. At the same time, agricultural yields in many regions would also increase significantly. In a recent publication they present a strategy to achieve these goals. The study is published in the journal *Nature Communications.*

The climate summit in Paris in 2015 was also the birth of the so-called '4 per 1,000' initiative. Its name stands for a link that has not received enough attention in climate research and politics for a long time: Every year the amount of carbon in the atmosphere increases by more than four billion tons due to the man-made greenhouse gas CO_2. If these four billion tons were instead sequestered in the Earth's soils (thus completely halting the greenhouse effect), the amount of carbon contained in the soil would grow by only 0.4 percent annually (i.e. 4 out of 1,000). In other words: Soils are already a gigantic carbon store. So why not simply dump the excess CO_2 in it as an additional minuscule amount?

Experts are indeed confident today that this strategy could significantly slow down climate change. "0.4 percent additional carbon input is somewhat too optimistic," explains Prof. Wulf Amelung, who heads the Division of Soil Science at the University of Bonn. "However, a third of this is probably achievable." Nevertheless, little has changed since 2015. Together with colleagues from Europe, the U.S., Australia and China, Amelung and colleagues therefore want to put the issue back on the agenda. In the current issue of the journal *Nature Communications*, they outline a strategy to effectively use the potential of soils in the fight against climate change. Amelung, together with his French colleague Prof. Abad Chabbi, is in charge of the initiative; in Germany, the TU Munich and Forschungszentrum Jülich were also involved.

There are a number of simple measures to increase the amount of carbon

in the soil, such as mulching (i.e. covering the soil with crop residues) or adding plant-based coal. The most important method, however, is to increase plant growth (and thus crop yields): by liming acidic soils, by fertilizing as needed, by using smart irrigation. "The more grows on the soil, the better is it rooted," explains Amelung. "And roots with their widely branching networks of organic material store lots of carbon." Conversely, the organic matter contains essential nutrients for plant growth and thus promotes crop yield. "Our strategy therefore ultimately addresses two important goals: climate protection and food security."

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Measures must be adapted locally

However, the global implementation of this ambitious plan is not quite so simple: The quality and characteristics of soils in different locations are too different, and the available management technologies are too dissimilar. "Increasing the carbon input therefore requires locally adapted measures; we need completely different strategies in the rice-growing regions of Asia than, for example, on a cereal field in northern Germany," Amelung emphasizes. In addition, many carbon sequestration measures are particularly effective when soils are partially degraded by long-term overuse and have lost a lot of carbon. "From a cost-benefit perspective, it certainly makes the most sense to start on such areas, not least because the yield increases are likely to be greatest there," explains the soil expert.

Unfortunately, however, knowledge about the condition of soil is very patchy. The researchers therefore recommend the establishment of databases that record the condition of land around the globe on a very small scale, as well as an equally small-scale modeling of possible yield gains and the necessary use of fertilizers. It must furthermore be ensured that there is no mere redistribution of carbon inputs: for example, organic material is moved from one farm to another at great expense and is now missing at its place of origin.

More information: W. Amelung et al, Towards a global-scale soil climate mitigation strategy, *Nature Communications* (2020). DOI: 10.1038/s41467-020-18887-7

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