'Planting' rocks in farms, along with emissions reductions, could help meet key IPCC carbon removal goal

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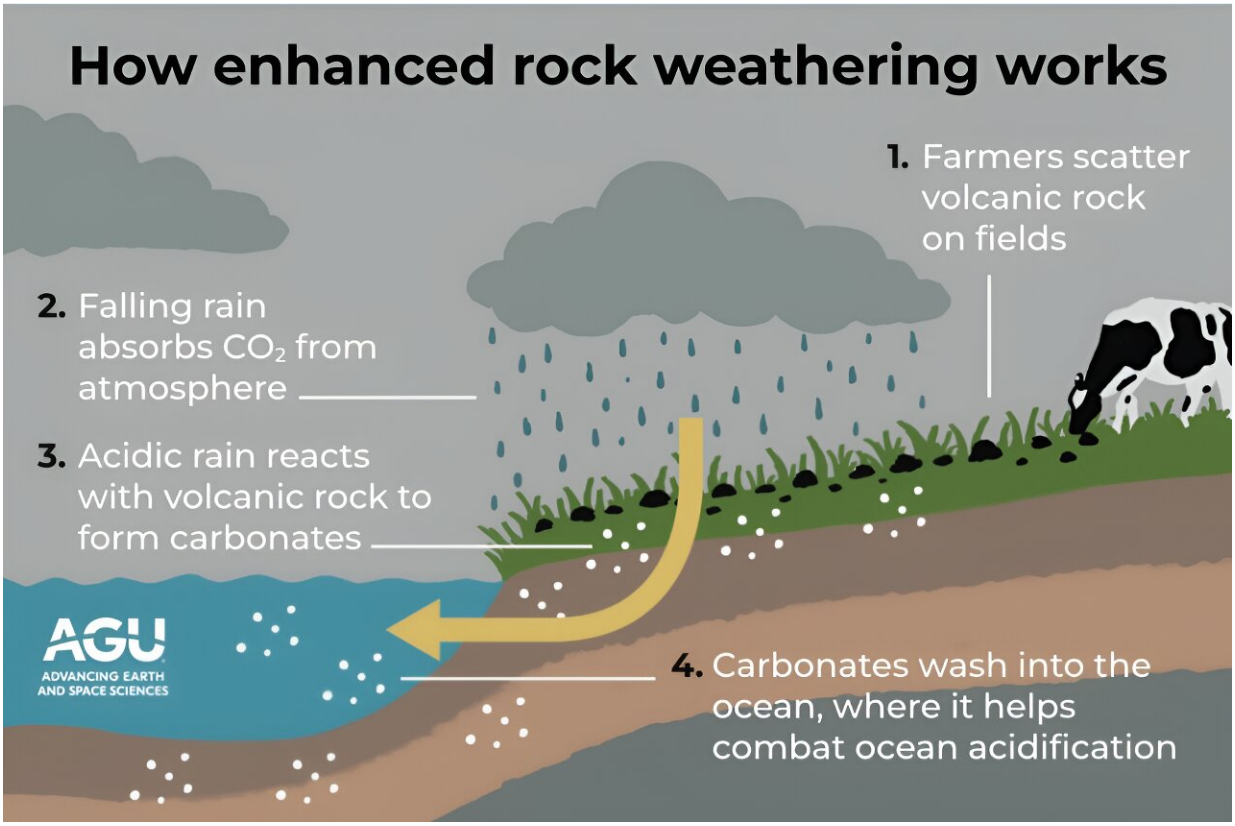

Enhanced rock weathering improves soil health, sequesters carbon, and combats ocean acidification. (Carbonates can also come from non-enhanced soil.) Credit: AGU

Farmers around the world could help the planet reach a key carbon removal goal set by the Intergovernmental Panel on Climate Change (IPCC) by mixing crushed volcanic rocks into their fields, a new study reports. The study also highlights wet, warm tropics as the most promising locations for this climate intervention strategy.

The study provides one of the first global estimates of the potential carbon dioxide drawdown from basalt application on agricultural fields worldwide. It was published in *Earth's Future*.

This type of climate intervention is called enhanced rock weathering. It takes advantage of the weathering process, which naturally sequesters carbon dioxide in carbonate minerals. The idea is simple: Speed up weathering in a way that also benefits people. When used in parallel with emissions reductions, it can help slow the pace of climate change.

And it may be a safer bet than other carbon drawdown approaches, according to the study authors.

"Enhanced rock weathering poses fewer risks compared to other climate interventions," said S. Hun Baek, a climate scientist at Yale University who led the study. "It also provides some key benefits, like rejuvenating depleted soils and countering ocean acidification, that may make it more socially desirable."

The new study explores the potential of applying crushed basalt, a fast-weathering rock that forms as lava cools, to agricultural fields around the world and highlights which regions can most efficiently break down the rocks.

"There's tremendous potential here," said Noah Planavsky, a geochemist at Yale University who co-authored the study. "Although we still have things to learn from a basic science perspective, there is promise, and we

need to focus on what we can do from market and finance perspectives."

A previous study used a separate method of calculating carbon dioxide removal to estimate carbon drawdown by the year 2050, but the researchers wanted to look beyond country borders and further into the future.

The researchers used a new biogeochemical model to simulate how applying crushed basalt to global croplands would draw down carbon dioxide, to test the sensitivity of enhanced rock weathering to climate and to pinpoint the areas where the method could be most effective.

The new model simulated enhanced rock weathering on 1,000 agricultural sites around the world under two emissions scenarios from 2006 to 2080. They found that in the 75-year study period, those agricultural sites would draw down 64 gigatons of carbon dioxide. Extrapolating that to all agricultural fields, representing the world's total potential application of this strategy, up to 217 gigatons of carbon could be sequestered in that time period.

"The latest IPCC report said we need to remove 100 to 1,000 gigatons of carbon by 2100 in addition to steeply reducing emissions to keep global temperature from rising more than one and a half degrees Celsius," said Baek. "Scaling up to global croplands, the estimates of carbon removal we found are roughly comparable to the lower end of that range needed to have a fighting chance of meeting those climate goals."

Because weathering progresses more quickly in hot and wet environments, enhanced rock weathering would work more quickly in tropical regions than higher latitudes, the study highlights. Farmers and companies looking to invest in carbon drawdown solutions make cost- and carbon-efficient choices by targeting basalt application in tropical fields.

The model revealed another promising result: Enhanced rock weathering works just as well, if not a little better, in warmer temperatures. Some other carbon drawdown approaches, such as those that rely on soil organic carbon storage, become less effective with continual warming.

"Enhanced rock weathering is surprisingly resilient to climate change," Baek said. "Our results show that it's relatively insensitive to climate change and works about the same under moderate and severe global warming scenarios. This gives us confidence in its potential as a long-term strategy."

Farmers already apply millions of tons of limestone (a calcium carbonate rock that can either be a carbon source or sink) to their fields to deliver nutrients and control soil acidity, so gradually changing the rock type could mean a smooth transition to implementing enhanced rock weathering at scale, Planavsky said.

Enhanced rock weathering has been applied on small scales on farms around the world. The next step is working toward "realistic implementation," Planavsky said.

More information: Seung H. Baek et al, Impact of Climate on the Global Capacity for Enhanced Rock Weathering on Croplands, *Earth's Future* (2023). DOI: 10.1029/2023EF003698

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