
Demystifying Carbon Dioxide Removal

February roundup

Dear all,

This is Jo from ZCA, covering for Victoria, who is enjoying a well deserved holiday. This month, we focus on nature-based solutions and look at progress in conserving forest, grassland and savanna carbon pools.

While inroads have been made in conserving forests - largely thanks to efforts by Brazil, Indonesia and Malaysia - deforestation continues to rise. Meanwhile, the inadequate conservation of savannas and grasslands is causing the release of unacceptable levels of carbon.

Tree planting initiatives have also come under fire for potentially threatening ancient grassland and savanna ecosystems and hampering their carbon sequestration potential.

New modelling suggests that the carbon removal potential of reforestation schemes may be grossly overstated, with the number of offset credits sold being almost three times higher than they should be.

A new analysis explores how the heavy reliance on afforestation, reforestation, and bioenergy with carbon capture and storage (BECCS) in Intergovernmental Panel on Climate Change (IPCC) pathways that delay emissions cuts now poses various risks to people and nature - including requirements for unreasonable amounts of land. But there is a solution - a pathway of aggressive emissions reductions now and a cap on future carbon dioxide removal (CDR) deployment is technically achievable.

We also assess whether seaweed farms could help us reach our carbon sequestration goals.

As always, please feel free to share this newsletter with anyone who may be interested. [Sign up is here](#), and [previous editions can be found here](#). Please get in touch with any questions, [suggestions or feedback](#).

Jo

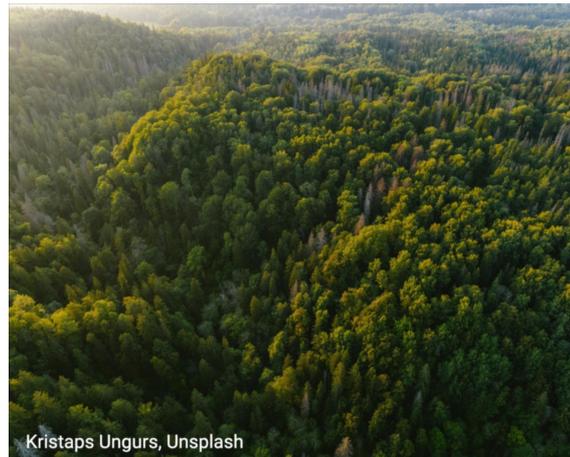
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Stat of the month:

7.6 billion metric tonnes

The estimated amount of carbon absorbed by forests each year, according to Nasa research.



Forests at risk

Forests are essential for limiting global warming to 1.5°C - they absorb around 7.6 billion metric tonnes of carbon every year, [which is one and half times the annual emissions of the United States](#). Yet despite 140 countries pledging at COP26 to end deforestation by 2030, [a new report estimated that deforestation increased by 4% in 2022 compared with 2021](#). The rates of deforestation in 2022 were 21% higher than what is needed to halt deforestation by 2030. [Deforestation rates would have been even higher](#) had Brazil, Indonesia and Malaysia not achieved drastic reductions.

The Democratic Republic of Congo (DRC), which is home to the second-largest rainforest in the world and the largest tropical peatland, has experienced [a steep rise in deforestation over the past two decades](#). Though estimates of emissions from land-use change are uncertain, deforestation in the country is believed to have released around 677 million tonnes of carbon dioxide equivalent in 2019. This is about the same as [Canada's total emissions in 2021](#), making the country the 12th-highest emitter globally despite using barely any fossil fuels.

The DRC's leaders have emphasised that financial support from wealthier nations is imperative to conserve the country's rainforests. However, global finance flows to nature-based solutions are critically lacking and will need to triple every year until 2030 for the world to meet global climate and biodiversity goals, according to the UN Environment Programme's recent [State of Finance for Nature report](#). Unfortunately, current spending on environmentally harmful subsidies is still [30 times higher than nature-positive investment](#).



“In 2020, around half of the soy produced on recently cleared land in Brazil was from the Cerrado.”

Despite progress on slowing deforestation in the Amazon, the clearing of Brazil’s subtropical [Cerrado savanna - which stores substantial amounts of carbon - to make space for agriculture increased by 43% last year](#).

“In 2020, around half of the soy produced on recently cleared land in Brazil was from the Cerrado,” said Mark Titley, a researcher at supply chain mapping initiative Trase. The [cleared land in the Cerrado generated the same amount of emissions as deforestation of the Amazon](#) that year, highlighting how conserving other ecosystems such as savannas and grasslands is essential for preserving important carbon pools.



Seeing the ecosystem for the trees

Soil is an important carbon pool, [storing at least three times the organic carbon of the atmosphere or terrestrial plants](#) for up to centuries. Soils in savannas and grasslands, which together cover up to 50% of the earth’s land surface, have stored around [640 million metric tonnes of carbon over the past two decades](#). But does planting trees in these ecosystems improve carbon storage? [Recent research](#) suggests not and argues that tree planting initiatives can worsen degradation.

Forest restoration projects under the African Forest Landscape Restoration Initiative (AFR100) - which aims to [restore 100 million hectares of deforested and degraded landscapes](#) in Africa by 2030 - have [come under fire by scientists](#). They warn that the initiative risks damaging ancient grassland ecosystems that absorb carbon dioxide, while at the same time failing to restore degraded land.

The initiative, which uses a widely used and problematic definition of forests as “areas that are covered in trees with canopy cover of at least 10%”, incorrectly identifies tropical grasslands and

savannas as forests. Increasing the tree cover in these ecosystems is unsuitable because it alters their functioning, with knock-on effects for carbon cycling.

Research published last year also [found that grasses rather than trees contribute the majority of soil organic carbon in tropical savannas and grasslands](#). Interestingly, the scientists found that increasing tree cover did not always result in a rise in soil organic carbon storage - emphasising that afforestation of these ecosystems may not be effective for carbon sequestration.

Ultimately, conserving ecosystems may prove more beneficial than planting trees, especially given that deforestation remains at high rates. Scientists also point to the fact that younger trees absorb less carbon than older trees, and that [natural forests store more carbon, and for longer, than plantation monocultures](#). But a warming planet is limiting the amount of carbon that forests can store. A new study found that [trees in hotter, drier conditions are struggling to draw carbon dioxide down from the atmosphere](#). This calls into question the capacity of forests to offset our emissions as the planet continues to warm - the [past year was 1.55°C warmer, on average, than preindustrial times](#).



Carbon offsets from forests exaggerated

An analysis of the carbon offset credits taken by a forest landowner found that [the carbon removal potential is exaggerated by almost three times](#). It is thought that this finding might be representative of the entire tree-planting sector. This is because the models used by the sector do not account for what happens to the wood once it has been logged - such as whether it is turned into furniture, plywood or paper.

The author of the study suggests that while carbon offsetting is important, its potential may not be as high as suggested by other analysts. By failing to consider the longevity of the stored carbon in the wood products, the accounting principles of the Paris Agreement - that [the carbon storage needs to have permanence](#) - have been neglected.



"Aggressively reducing emissions now and placing a cap on future CDR deployment could alleviate sustainability risks, such as those posed by unrealistic land requirements."

Land-based CDR risks under spotlight

As governments and industries keep delaying meaningful emissions cuts further into the future, reaching Paris Agreement goals will depend more and more on large-scale deployment of CDR. While afforestation, reforestation and BECCS are widely deployed in the 1.5°C IPCC pathways, their demand for land and the risks this imposes on nature and society have not been fully explored - until now.

[A paper published in Science in February](#) quantified the ecological and societal risks from different levels of CDR deployment in IPCC pathways. The findings highlight how aggressive CDR deployment later in the century is no substitute for rapid emissions cuts now. Relying on CDR without cutting current emissions will create risks to food security, human rights, water security and biodiversity and overstep the [safe operating space for humanity](#).

Only those pathways curbing warming to 1.5°C with limited to no 'overshoot' - where temperatures exceed 1.5°C for a period of time before returning - do not greatly overstep planetary boundaries and pose the least societal risk. Not only do pathways with high overshoot or that limit warming to 2°C come with far greater risks and challenges, but their requirements for land are unrealistic. In the pathway limiting warming to 1.5°C with high overshoot, [the amount of land needed for CDR by 2100 would be one and half times the size of the United States](#). "It is obvious that this is by no means feasible," said [Felix Creutzig, co-author of the study](#).

[The authors say](#) that their findings emphasise the need for sustainability risks to be considered when choosing between different mitigation pathways, and for scientists to identify pathways that do not overstep sustainability limits. These pathways could be a key consideration for the next IPCC report - which could in turn inform countries' upcoming climate plans under the Paris Agreement.

One solution [to avoiding sustainability risks](#) could be through aggressively reducing emissions now and placing a cap on future CDR deployment, another study found. "Excessive reliance on future CDR entails serious risks, including delayed emissions cuts, lock-in of fossil infrastructure, and threats to sustainability from increased resource competition," the authors said.

Alternatively, investing in renewables, green fuels and electrification would reduce greenhouse gas emissions, air pollution and fossil fuel use. It would also avoid many of the risks posed by the over-reliance on CDR, such as increased competition over scarce land, water and fertilisers.



Lasse Møller, Unsplash

Is farming seaweed the answer?

[Almost all currently deployed CDR capacity is land-based](#), but marine or ocean-based CDR is generating increasing interest. The [ocean stores 20 times as much carbon as every plant and plot of soil on land combined](#), and a substantial amount of this carbon is stored in algae - or seaweed. This has spurred interest in [seaweed farming as a CDR solution](#), including by [carbon credit schemes](#).

But the efficacy and permanence of the [carbon sequestration by farmed seaweeds has been questioned](#), as has the financial and practical feasibility of expanding seaweed farms into the open ocean. A [review of over 100 scientific papers on the carbon storage capacity of seaweed farms](#) found that most of the carbon fixed in seaweed is only stored in short-term reservoirs. With farmed seaweed currently occupying a tiny fraction of the space occupied by wild seaweed, the sequestration potential will be limited in the near to mid term. Estimates also suggest that any CDR by seaweed farms will be offset by their emissions, as the materials and energy used by these farms are currently dependent on fossil fuels.

Scientists also warn that [measuring carbon sequestration in the marine environment is incredibly complex](#) compared to land, meaning that quantifying the CDR and carbon sequestration of seaweed farms will be challenging. On the contrary, [natural seaweed forests have various benefits for the health of marine ecosystems and the people](#) who rely on them, and therefore they should be conserved.



Matt Palmer, Unsplash

Our pick of the news

[EU CO2 rules boost farmers, annoy environment activists](#) (AFP via Barrons)

The EU agreed on “new rules for certifying carbon removals - including CO2 stored in farmland - creating potential new revenue streams for struggling farmers but alarming environmentalists.”

[Side-effects of expanding forests could limit their potential to tackle climate change – new study](#) (The Conversation)

Findings from a new study suggest that “while forestation - the restoration and expansion of forests - can play a role in tackling climate change, its potential may be smaller than previously thought.”

[The Wild West carbon credit era might be coming to an end as sales hit record high](#) (Business Insider)

“Carbon credits have faced intense criticism around quality and their actual impact on emissions, but the industry has set about bringing its Wild West era to an end - and there are signs it's working.”

[Why oceans are key to saving our planet from climate change](#) (San Francisco Chronicle)

“In recent years, climate scientists began exploring ways to build upon that natural process to increase the ocean's capacity to absorb and permanently store carbon dioxide. Scientists around the world ... have focused on a specific approach that can do just that, known as ocean alkalinity enhancement, or OAE.”

[Cerrado: Beef trade risks key Brazil ecosystem - campaigners](#) (BBC)

“A new investigation from international environmental and human rights charity Global Witness ... reveals the extent to which this Cerrado deforestation is illegal and is being driven by the cattle trade.”

[PUB to build world's largest facility to help remove CO2 from ocean](#) (The Straits Times)

“The US\$20 million (S\$27 million) plant, once fully operational in 2025, will be able to remove some 3,650 tonnes of CO2 from the ocean yearly, while helping PUB to decarbonise its water treatment processes”



Useful resources this month

A newly-released knowledge hub on CDR, called [GENIE CDR Knowledge Hub](#), synthesises key information and provides public access to key data sources.

[Ocean Visions has released an interactive database of marine carbon dioxide removal field trials](#) by research institutes, start-ups and others, aimed at improving knowledge-sharing and awareness of the state of development of ocean-based CDR.

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Each month the demystifying carbon dioxide removal newsletter digs into the world of CDR to bring you the latest stories on everything from carbon credits and net-zero plans to nature-based solutions (NbS) and new technologies. Feel free to forward this email to your colleagues!

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