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How the pernicious promises of imaginary carbon removal harm essential climate action

The media, exemplified by the UK's Guardian newspaper leapt on a recent scientific assessment of the climate potential of forest restoration, inflating and amplifying the already exaggerated claims made in and about the study by its authors. This case is only the most recent, but perhaps most worrying example yet of 'pernicious promises' of carbon removal. Such research, and especially such media coverage, is not only misleading, but could be dangerous.

Why was the reforestation study misleading?

Most debate on this so far has focused on whether the 205Gt-C estimate of potential is really equivalent to two thirds of the accumulated anthropogenic *carbon burden* – a rather arcane question that depends heavily on whether you count carbon already absorbed from the atmosphere by oceans or ecosystems as part of the anthropogenic burden; and also on just how much of anthropogenic emissions has been so absorbed. But to present this as a claim that 2/3rd of *cumulative emissions* can be recaptured (as the Guardian did, without even mentioning the absolute figure) is definitely misleading. Since 1860, humans have emitted over 600Gt-C, and even if an estimate of 205Gt-C for potential forest removals were correct, it would constitute no more than one third of this. Two hundred gigatonnes may be roughly two thirds of the amount emitted that is still left in the atmosphere, but if that much were actually removed, it would trigger significant outgassing from the oceans, and would not reduce atmospheric concentrations proportionately. Perhaps more significantly, the paper's estimates of how much carbon each hectare of forest could absorb, and how quickly, have also been questioned.

There are other problems too. The article describes simplistic top-down modelling, adding up the visible unforested area suitable for tree growth - based on satellite data - to generate a "maximum potential" figure. This effectively double-counts some of tree planting's additional potential to benefit the climate by not subtracting existing commitments to restoration, which may be already included in countries' climate plans and in the climate pathways generated by integrated assessment models. The study also paid little attention to feedbacks that could reduce the impacts of tree-planting on climate change. For example replacing snow-covered tundra with trees makes the earth's surface less reflective, raising

temperatures locally and potentially leading to releases of the powerful greenhouse gas methane from warmer tundra soils.

Most critically such maximum figures overlook critical social, political and economic constraints. To assume that all existing farmers and other land managers would embrace such dramatic changes in land use regardless of social, political or cultural factors is simplistic. When we take people into account such technical potentials become much smaller. Forests will only thrive as carbon sinks if managed appropriately and supported by local communities. In many parts of the world this will be difficult to achieve, due to their still unfolding histories of colonialism and land-grabbing.

And economics matter too. While the article itself includes no costings, the scientists involved provided journalists with a best-case estimate of just USD$300 billion to plant trees on 0.9 billion hectares. This is equivalent to less than USD$0.40 per tonne of CO_2 for the 205Gt-C (750Gt-CO_2) removed. But more detailed studies of the costs of carbon removal through reforestation put the figure closer to USD$20-50 per tonne of CO_2 – and even this may be optimistic at such large scales.

It would be interesting to speculate on why journalists, and particularly headline writers, feel so forced to exaggerate climate stories that so many of them now read as magical salvation, or else disaster porn; and why scientists so willingly accommodate the media's demands for grand narratives devoid of messy caveats. But here we want to explain why it is so problematic.

Why could it be dangerous

The key point here is not simply that in practice, delivery would be lower and more costly than suggested, but that such promises about cheap and powerful carbon removal techniques – whether about forests, or enhanced weathering, or ocean fertilisation - could deter or delay existing and essential action to cut emissions.

Our research suggests that the promises implied in such studies, and the associated reporting, could set back climate action, because of what we term 'mitigation deterrence'. Promises of cheap, easy carbon removal make it less likely that time and money will be invested in urgently needed emissions reduction.

Such promises have discursive or narrative power, structuring and changing the boundaries of possibility – especially when wrapped in quantitative modelling. They enable prevarication, and delay. Of course, proponents say that carbon removal needs to be additional to other action. But that action requires investment, policy and commitment. It seems less likely that financiers or governments would invest in emissions reduction or carbon removal techniques costing tens or hundreds of dollars a tonne when they – and shareholders and voters - are being told that huge amounts of carbon removal can be done

for a few dollars a tonne by planting trees or fertilising the oceans. Such promises would also embolden those vested interests that want to sustain fossil fuel extraction or use. We cannot expect energy companies and airlines to plan to restrict their extractive or expansionary ambitions, if they expect to be able to buy offsets for everything they generate for just $0.40 a tonne. And in such circumstances, with lowered willingness to pay anything higher, prices in carbon trading markets would be suppressed below the levels needed to trigger adequate emissions reduction. For example, the UK's net-zero target for 2050 implies carbon prices of up to $200 a tonne of CO_2.

Such rhetorical promises of technical potential, abstracted from politics, economics and culture, encourage a managerial, administrative, technocratic model of governance that acts to depoliticize the problem at a large scale. Although such promises look good in spread-sheets and models, when they meet the material and political world, failure is more likely than success. If addressing climate change really were so cheap, we'd be the first to celebrate. But if such cheap solutions prove much more limited or more expensive, the delays to other options could prove devastating. We saw this with the promises and expectations around carbon capture and storage (CCS), where technocratic expectations that CCS would provide a cheap solution to cutting fossil emissions, set out in sector 'road-maps' have been thwarted by an intersection of public concerns about leakage and pipelines, and commercial reticence to invest in CCS in the absence of support and infrastructure. In the interim emissions have continued to rise, and the continued promise of CCS has provided an alibi for further investments in fossil fuel extraction, notably in fracking.

That same technocratic model of climate governance has embraced ideas of carbon pricing and climate offsetting. But the practicalities of such tools make these promises even more dangerous. Treeplanting can become corporate greenwashing. Tree-planting financed through offset markets would guarantee that the polluters buying offsets continued to emit CO_2, but cannot guarantee removals to match those emissions. Not only do studies suggest that the majority of offset projects would have happened anyway, but such schemes are vulnerable to fraud, management failure and accidents. So trees might never be planted, or be logged rather than maintained, or be caught up in wildfires.

Finally, such promises collapse timescales, allowing future imagined carbon removal to substitute for action now. In this case this problem is exacerbated because carbon removal by trees is very slow as well as hard to measure and – moreover – hard to sustain, in the face of a warming climate, and more frequent wildfires. The problems of collapsed timescales are exacerbated by economic discounting. In models, carbon removal options act like time-machines, compensating for excess emissions today with removals in the future. With the benefits of discounting these imagined future removals also look misleadingly cheap, and in an effort to optimise costs, the integrated assessment models tend to generate pathways with reduced short term mitigation, replacing it with imaginary removals late in the century.

Nature or technology, or both?

For all these reasons presenting maximum estimates of global potential for carbon removal without careful consideration of economic, social, environmental and political caveats can be pernicious. The example of forest restoration brings other particular worries, falling as it does clearly to one side of a (arguably false) nature: technology divide. We know publics show (arguably) irrational preferences for 'natural-sounding' climate interventions and nature-based 'solutions'. We also know that many people and some environmental campaign groups strongly object to 'technological fixes', preferring behavioural and political change. Presenting forest restoration as a magical solution could reinforce both these views. This could undermine not only the pursuit of technological carbon removal options like bioenergy with CCS or direct air capture, but also the pursuit of technological approaches to emissions reduction such as wind-power or high-speed rail. This can be seen to further polarise debate over climate responses into a battle between technological and natural solutions, distracting from the critical challenges of politics, economics and culture which are already delaying climate action of all kinds.

Reforestation has a role in tackling climate change, but so do more technological responses for both emissions reduction and carbon removal to climate change. And tree-planting bring many other benefits in many places: improved drainage, cooling shade, and more wildlife to name but a few. Incentives for reforestation are therefore important. And so are incentives for carbon removal. But we should not make trees – nor technology - carry the entire burden. Tackling climate change requires us to move beyond technical questions, to deliver immediate political action to cut emissions, and to begin to transform economies and societies towards sustainability.