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"Nature-based solutions" (NbS) and claims about their mitigation potential

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The International Union for the Conservation of Nature (IUCN) introduced the term "nature-based solutions" (NbS) into the global policy space in 2016. The term has attracted a great deal of attention and use in the past five years, with a large emphasis put on the potential of nature to "solve" climate change. In 2017, a group of scientists associated with The Nature Conservancy published an academic article titled "Natural Climate Solutions", again proposing that "nature" might be a climate change "solution." That article proposed that implementing a set of 20 practices ("natural climate solutions" (NCS)) might provide "37% of cost-effective CO_2 mitigation needed through 2030 for a >66% chance of holding warming to below 2°C."[1]

Current climate and biodiversity discourse is filled with claims that "nature", NbS or NCS can meet an important fraction of the global mitigation goal under the Paris Agreement. The exact fraction cited varies with the source. One can find references to "30%",[2] "around one-third"[3] or "approximately one-third",[4, 5] and "more than one-third",[6] in addition to the number published in the original paper: "37%".[7] The sources vary as to whether or not they include more qualifying language beyond the base figure, such as the time

1 Griscom, B.W. et al. 2017. Natural climate solutions. https://www.pnas.org/content/114/44/11645. A 66% chance of staying below 2°C is rather far from what parties have agreed to in the Paris Agreement. The Paris Agreement language is "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and … pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels …"

2 In reference to voluntary REDD offset credits, the website https://opensea.io/collection/creol-verified-carbon-units claims that "This [the credits] in turn can address 30% of worldwide emissions today."

3 "It is estimated that NCS projects can help deliver around one-third of net emission reductions needed by 2030." Bill Winters, foreword, Consultation: Nature and net zero. World Economic Forum, January 2021.

4 The documentation for the 2020 UN Summit on Biodiversity claims that "nature-based solutions can provide approximately one-third of the solutions needed to achieve the climate mitigation targets of the Paris Agreement." https://www.un.org/pga/75/united-nations-summit-on-biodiversity/

5 "NBS could provide approximately one-third of the cost-effective climate mitigation needed to deliver on the 1.5°C target." Seymour, F. and P. Langer. 2021. Consideration of nature-based solutions as offsets in corporate climate change mitigation strategies. WRI Working Paper.

6 "Actions to avoid, reduce and reverse land degradation can provide more than one-third of the most cost-effective climate mitigation needed to keep global warming under 2°C by 2030 (established but incomplete)." https://ipbes.net/assessment-reports/ldr

7 Griscom et al. 2017.

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frame covered or the temperature target (1.5°C or 2°C). They also vary with respect to the types of actions that might deliver the mitigation effort.[8] Sometimes the numbers are said to refer to the potential of NbS, other times of NCS.

These sorts of inaccurate reflections of the underlying science are quite common, and there is a proliferation of related false and misleading claims about the role that "nature" can play in climate change mitigation. Experts have raised a range of concerns about the assumptions and methodology in the original NCS paper, and a consequent overestimation of actual mitigation potential. In this briefing paper, we examine misleading uses, inaccuracies, the assumptions used to generate the claims about the mitigation potential of nature, and the validity of those claims.[9]

Are NbS and NCS different?

NbS and NCS sound very similar and the terms are often used interchangeably in erroneous ways. Scientists at the Oxford-based Nature-based Solutions Initiative note that NCS refers to a subset of NbS: "conservation and management actions that reduce greenhouse gas (GHG) emissions from ecosystems and harness their potential to store carbon".[10]

NCS are often sorted into three different types of climate change mitigation actions: protecting ecosystems (particularly forests), better managing ecosystems under human control (forests, croplands, grazing lands), and restoring ecosystems (forests, mangroves, peatlands).[11] These "nature-based" or "natural" practices could either ***reduce*** or ***avoid emissions***, for example by not cutting down trees or avoiding the use of synthetic nitrogen fertilizers, or ***enhance sinks***, for example by planting trees in agroforestry systems.

In the original 2017 NCS article, Griscom and his co-authors described 20 specific types of NCS. These 20 NCS include: reforestation, avoided forest conversion, natural forest management, improved plantations, avoided woodfuel use, fire management, biochar, trees in croplands, nutrient management, grazing (feed, animal management, optimal stocking intensity, legumes), conservation agriculture, improved rice management, avoided grassland conversion, coastal restoration, peat restoration, avoided peat impacts, and avoided coastal impacts. The largest mitigation contributions described in the article potentially come from reforestation and avoided forest conversion.

Unpacking the 37% figure

The Griscom et al. article concludes that "Natural climate solutions [the 20 listed above] can provide 37% of cost-effective CO_2 mitigation needed through 2030 for a >66% chance of holding warming to below 2°C." Several elements of this conclusion should be highlighted and unpacked here, starting with the question: ***37% in relation to what?*** Important variables and assumptions made in the paper include how much mitigation might be needed yearly and what quantity of removals could be possible within natural systems.

The article relies on a series of contestable framings and assumptions:

- The article looks only at mitigation needed ***until 2030***.
- Somewhat surprisingly, the model assumes that ***fossil fuel emissions continue unchanged throughout the decade of analysis***.
- Determining what is "cost-effective" relies on assumptions and judgments about costs of current and future mitigation actions.

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8 With respect to the sources cited above, these actions include voluntary offsetting based on REDD projects, NbS, and "actions to avoid, reduce and reverse land degradation."

9 This briefing paper builds on analysis in a longer paper, "Nature-based solutions" and the biodiversity and climate crises, available at https://twn.my/title/end/pdf/end21.pdf

10 Seddon, N. et al. 2020. Understanding the value and limits of nature-based solutions to climate change and other global challenges. https://royalsocietypublishing.org/doi/10.1098/rstb.2019.0120

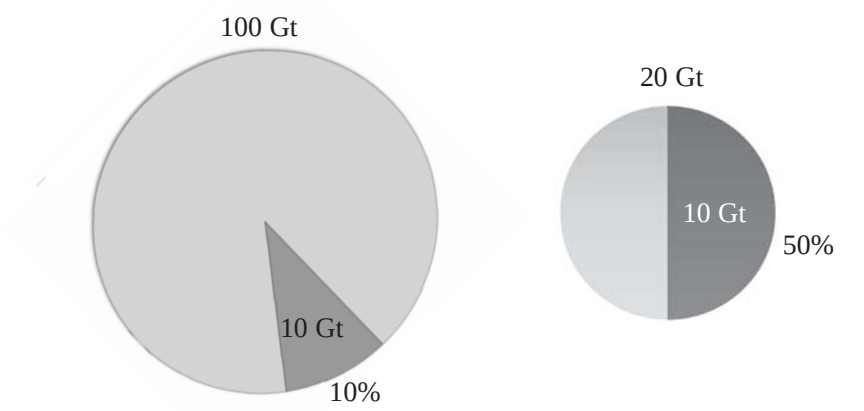
11 Girardin, C.A.J. et al. 2021. Nature-based solutions can help cool the planet – if we act now.

- The mitigation objective defined in the analysis is to hold warming to below 2°C, and ***only with a 66% chance of reaching that objective***. In contrast, the Paris Agreement's aims include:

  holding the increase in the global average temperature to ***well below 2°C*** *above pre-industrial levels and to pursue efforts to* ***limit the temperature increase to 1.5°C*** *above pre-industrial levels.* (Article 2.1(a)) [emphases added]

37% in relation to what? Whether the total amount of overall mitigation effort required is small or large makes a difference. If the overall mitigation effort assumed in Griscom et al. (30 Gt) is rather underestimated in relation to what is actually necessary to meet the Paris Agreement goals (45 Gt), the potential contribution of NCS to that effort would look large (see graphic). Conversely, if the mitigation effort needed between now and 2030 were much greater than that assumed in the article, then the fractional contribution of NCS to that mitigation effort would be a good deal smaller than 37%.

Percentage contribution of 10 Gt of NCS under different mitigation scenarios (example, not to scale)



If total mitigation 100 Gt
10 Gt is 10% of the total mitigation

If total mitigation 20 Gt
10 Gt is 50% of the total mitigation

The resulting fractional contribution to the mitigation effort depends on the overall mitigation effort

Indeed, the amount of mitigation effort needed for just a 66% chance of staying below 2°C is ***far smaller*** than the amount of mitigation effort needed, for example, for a 90% chance of staying below 1.5°C. And actually relying on reductions in fossil emissions to deliver most of the mitigation effort in the next decade (in line with what the science requires) will necessarily reduce the relative contribution of NCS. The devil is thus in the details: 37% of what?

Examining assumptions and assessing the validity of the NCS claims

In this section we examine three aspects of the article and its conclusions in more detail:

- **There are rather contestable assumptions upon which the conclusions are based.** These are usually hidden in dense scientific writing and supplementary information published alongside the article. These assumptions should see the light of day, not only in the scientific article, but also in the pronouncements of policymakers.
- **There are important differences between two different categories of nature-based mitigation** – avoiding emissions (e.g., avoided deforestation) and enhancing removals by sinks (e.g., forest restoration) – which means they cannot be simply added together in a single number (37%).

- **Aggressive climate action requires dramatic cuts in fossil emissions this decade.** How useful, and to whose benefit, is a number that is based on an assumption that there is no reduction at all over the next decade in fossil fuel contribution to atmospheric CO_2 concentrations?

1. <u>Any claims of climate impact are misleading if the assumptions behind the modelling are not made clear and/or if they are not credible.</u>

The article's modelling relies on making many, many assumptions about actors and systems included in the analysis, as all models do. What assumptions are made will affect the model's output. Here are two examples of assumptions made in the article, related to deforestation and reforestation:

- To assess the potential contribution of avoided deforestation, the authors have made assumptions about how much deforestation might take place if forests were not protected, and how much people are willing to accept in payment to not cut down trees. They make baseline assumptions about rates of deforestation into the future to estimate that a certain amount of emissions will be avoided. The greater the baseline assumptions about the extent of deforestation in 2030, the greater the mitigation potential (as avoided emissions) that can be claimed from halting deforestation.
- To estimate the potential for reforestation, the article assumes that "all grazing lands in forested ecoregions can be reforested." This is linked to an assumption about significant reductions in global consumption of beef. The consequences of such assumptions are that they lead to a possibly large overestimation of the mitigation potential of reforestation.

2. <u>Avoided emissions and enhanced removals are not interchangeable and should not be added together.</u>

The authors measure the mitigation potential of actions that either reduce or ***avoid*** GHG emissions in the first place or ***remove*** carbon dioxide that is already in the atmosphere by increasing carbon sequestration in natural and managed ecosystems – as sinks.

Approximately half of the mitigation potential identified in the original NCS article is from avoided emissions (5.7 Gt CO_2-eq) and half due to additional CO_2 sequestration (5.6 Gt CO_2-eq) (i.e., removals). The 37% figure is based on just adding these figures together.

Yet, the climate change impacts of these two types of actions – avoidance and removals – are quite different. In the first case, the emissions have not yet happened, and as pointed out above, estimating what may happen 10 years from now in the absence of climate action is a speculative exercise, and easily manipulated.

In the second case, removals take carbon dioxide out of the atmosphere that has already been emitted. However, removals by terrestrial ecosystems – forests, grasslands, soils – are by their very nature impermanent. Soils may store carbon until the field is ploughed or drought or flooding causes the soils to become degraded. Forests may store carbon until insect-damage, drought, fire, or any combination of those impacts causes degradation or loss.

Simply put, for scientific and policy-relevant purposes, the quantities of CO_2 associated with avoided emissions and enhanced sinks cannot be added together; any figure that aggregates emissions and removals will lack accuracy and credibility.

Examples of reduced or avoided emissions	**Examples of enhanced sinks or removals**
Avoided deforestation	Forest and other ecosystem restoration
Avoiding the use of synthetic nitrogen fertilizers	Planting trees, for example in agroforestry systems

3. Setting low overall mitigation objectives makes the mitigation potential of NCS seem large.

It is a relatively straightforward exercise to make NCS contributions to mitigation goals seem large, if in fact the rest of the assumed mitigation actions are not particularly ambitious to begin with.

To estimate the mitigation contribution of NCS, the authors must make assumptions about what mitigation actions will or will not be undertaken in other sectors, and on which time frame. In the article, "*it is assumed that fossil fuel emissions are held level over the next decade* then decline linearly to reach 7% of current levels by 2050." [emphasis added]

The scenario described is extremely unambitious, leading to warming well beyond what the Paris Agreement sets as its goal. By setting a low-ambition target, including one that assumes fossil fuel consumption remains steady throughout the decade, the mitigation potential from the 20 NCS actions seems large.

The land sector, or more specifically NCS, no doubt has an important role to play in climate change mitigation. It is critical to reduce and avoid emissions from natural sources. Enhancing sinks is also critical. However, what these numbers actually show is not the great potential of NCS, but rather the relatively limited, but still important, contribution over the next couple of decades that natural systems can make to the mitigation effort ahead.[12]

It is imperative to dramatically and urgently reduce fossil emissions.

Conclusion

It is certainly critical to conserve biodiversity and natural ecosystems for many reasons, including because of the role they can play in both mitigation and adaptation, but this contribution should not be overstated or misused at the expense of doing nothing much about reducing emissions. Additionally, it appears that there may be vested interest in claiming such large mitigation potential of NbS, because through using NbS to offset carbon emissions, increased funding for biodiversity conservation can be generated. However, this is often without due attention to the rights of Indigenous Peoples and local communities.

What this analysis actually shows is that nature can only do so much. It also demonstrates how certain scientists and environmental organizations have taken on a piece of the public relations work of the fossil fuel industry and countries unwilling to make drastic emissions reductions.

The figures are being used and misused in attempts to convey that there is an easy path out of the mess that we are in, that is, that nature can provide an ample amount of mitigation in the short term, so there is no need right now to do the difficult task of drastically reducing emissions. There is also simply a cynical use of the figures, to pretend there is a scientific basis for complacency and lack of real action. Perhaps to also restate the obvious, as with NbS, NCS are not "solutions" in any real sense of that term. In sum, a large number of misinterpretations, uncertainties, assumptions, and obfuscations combine to make the 30%/37% figure inaccurate and misleading, and its use should be avoided.

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[12] House, J. et al. 2002. Maximum impacts of future reforestation or deforestation on atmospheric CO2. *Global Change Biology* 8(11): 1047-1052; Mackey, B. et al. 2013. Untangling the confusion around land carbon science and climate change mitigation policy. *Nature Climate Change* 3: 552-557.