NCS Atlas Natural Climate Solution pathway descriptions and references

Cost-effective

When "Cost-effective" is unchecked, we present the maximum mitigation potential offered by natural climate solutions. Maximum refers to the total amount of climate mitigation possible through the implementation of pathway activities from a natural or managed system, considering nature's full biophysical ability to store or absorb carbon based on its total global extent. Under this scenario, implementation of pathway activities is not limited by cost, but it is constrained only by maintaining land area to meet society's requirements for food and fiber (e.g. generally maintaining existing reduction in cropland area). NCS pathways are also selected and defined to exclude "activities that would either negatively impact biodiversity (e.g., replacing native non-forest ecosystems with forests) or have carbon benefits that are offset by net biophysical warming (e.g., albedo effects from expansion of boreal forests)" (Griscom et al. 2017).

When "Cost-effective" is checked the Atlas presents the mitigation potential based on global and regionally derived marginal abatement costs (MAC) of ≤$100USD/tonne CO_2e in 2030. This does not directly reflect country-specific economic studies; therefore, we advise the viewer to interpret the cost-effective designation as an approximation.

Scientists project that climate change will cost society more than $100 per tonne of CO_2e emitted if we fail to achieve the Paris Agreement goal of limiting warming to below 2°C. Therefore, spending up to $100 per tonne should be considered cost-effective. This cost-effective proportion of the maximum potential mitigation total is the best measure for understanding society's ability to employ natural climate solutions as a response to climate change.

Scale by country area

When checked, this presents NCS Mitigation density per unit land area; calculated by dividing a country's NCS mitigation potential by its total land area.

NCS Pathway Categories (excerpted verbatim from Griscom et al, 2020)

<u>Protect</u> - pathways that prevent the loss of native ecosystems.

<u>Manage</u> - pathways that avoid GHG emissions or enhance carbon sinks on working lands through improved management practices that do not reduce existing food, fiber or plant fuel yields (except where balanced by other pathways that increase yields).

<u>Restore</u> - pathways that expand the spatial extent of native cover types, including forest and non-forest ecosystems to areas from where they had previously been lost as a result of human activity.

NCS Pathways

Reforestation

Temperate and tropical lands that were once forested (> 25% tree cover) but were cleared by human activity are potentially eligible for reforestation. However, lands used to grow food crops or within biologically important grass-dominated ecosystems, are considered ineligible for reforestation. Areas where forests are only temporarily cleared or covered by other NCS are also excluded (Griscom et al. 2017, Fargione et al. 2018 [US only]). Estimates of carbon accumulation potential derive from Cook-Patton et al. 2020 (non-US countries).

Avoided Forest Conversion

Activities in this pathway prevent the loss of natural forests in the tropics. As with other pathways, forests include land that has trees covering more than 25% of its area, excluding wetlands, which are considered separately. (Busch et al. 2019) (Griscom et al. 2020), (Fargione et al. 2018 [US only])

Natural Forest Management

Selectively removing certain trees along with allowing more time for the forest to recover between logging cycles can both reduce emissions from timber harvesting and increase the carbon sequestered in healthy native forests. (Griscom et al. 2020), (Fargione et al. 2018 [US only])

Avoided Woodfuel Harvest

Avoiding CO_2 emissions by reducing the amount of wood harvested for cooking and heating, without reducing heating or cooking utility. We employ their assumption that improved cookstoves can reduce carbon emissions. (Griscom et al. 2020)

Savanna Burning

The approach reduces green-house gas (GHG) emissions from savanna burning by intentionally burning savannas during the early dry season, when fires are generally smaller, less intense, and release fewer emissions, with the goal of reducing fire occurrence, intensity, extent, and emissions late in the dry season. (Lipsett-Moore et al. 2018)

Biochar

Biochar is a soil amendment produced from burning crop residue in low oxygen conditions. When applied, it can significantly increase soil carbon, and has potential agronomic benefits. (Griscom et al. 2017), (Fargione et al. 2018 [US only])

Trees in Agriculture Lands

Additional carbon sequestration in above- and below-ground tree biomass and soil carbon due to integration of trees into croplands at levels that do not reduce crop yields. This includes windbreaks/shelterbelts, alley cropping, and farmer managed natural regeneration. (adapted from Chapman et al. 2020 and Griscom et al. 2017)

Nutrient Management

With improvements in the timing, placement, and form of fertilizer such as manure, farmers can achieve significant improvements in efficiency and reduce over-application without negatively impacting crop yields. (Griscom et al. 2020), (Fargione et al. 2018 [US only])

Grazing – Optimal Intensity

Overgrazing reduces plant productivity and reduces soil carbon. Optimizing grazing levels maintains productive grasslands and increases soil carbon. (Griscom et al. 2017), (Fargione et al. 2018 [US only])

Grazing – Legumes in Pastures

Planting legumes such as alfalfa, clover, peas, or beans in managed pastures adds carbon to the soil while providing increased forage for cattle and other livestock. (Griscom et al. 2017), (Fargione et al. 2018 [US only])

Avoided Grassland Conversion

Protected areas establishment and improved enforcement to prevent conversion of grasslands and shrublands to tilled croplands; improved land tenure; intensification of existing croplands. (Griscom et al. 2017), (Fargione et al. 2018 [US only]) (Sanderman et al., 2018) (Liu et al., 2020)

Improved Rice Cultivation

Water management techniques such as alternate wetting and drying (AWD) and midseason drainage (MSD) reduce annual methane emissions while at the same time saving water. (Griscom et al. 2017), (Fargione et al. 2018 [US only])

Peatland Restoration

Degraded peatlands are responsible for a large portion of the carbon emissions from natural systems. The primary method of peatland restoration involves "re-wetting" or restoring natural water flows and soil saturation to prevent the further breakdown of plant material and capture new plant debris from the growing vegetation aboveground. (Griscom et al. 2020), (Fargione et al. 2018 [US only])

Avoided Peatland Impacts

When peatlands are drained, for palm oil or other crops, their stored carbon is released into the atmosphere. Drained peatlands are susceptible to fires, further amplifying their carbon emissions. (Griscom et al. 2020)

Avoided Mangrove Impacts

Mangroves conversion - development and shrimp farming as well as polluted runoff damage the mangrove plants and lead to the release of carbon trapped in their soil. Preventing these impacts maintains healthy functioning coastal wetlands that store and absorb carbon from the atmosphere. (Griscom et al. 2020)

Mangrove Restoration

Rehabilitating and/or regenerating mangrove habitat that has been converted or is in a degraded condition prevents continued oxidation of soil carbon and enhances soil carbon sequestration. (Griscom et al. 2020)

Citations

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