

# Comment

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Supplementary information to:

## Adopt a carbon tax to protect tropical forests

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## Supplementary information

### The case for a tropical carbon tax

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**Table S1. A tropical carbon tax in megadiverse countries.**

Countries <sup>a</sup>	Forest loss (2018) <sup>b</sup>		Fossil fuels (2014) <sup>c</sup>	Policy A (revenues year <sup>-1</sup> ) <sup>d</sup>			Policy B (revenues year <sup>-1</sup> ) <sup>e</sup>		
	Area (kha)	CO <sub>2</sub> emissions (Mt)	CO <sub>2</sub> emissions (MtC)	Total (\$M)	NCS (\$M)	NCS \$ ha <sup>-1</sup> forest loss <sup>f</sup>	Total (\$M)	NCS (\$M)	NCS \$ ha <sup>-1</sup> forest loss <sup>f</sup>
Brazil	2,830	1,000	144.5	722.4	216.7	77	2167.2	1517.0	536
Colombia	347	142	22.9	114.7	34.4	99	344.0	240.8	694
Dem. Rep. Congo	1,370	556	1.3	6.4	1.9	1	19.1	13.4	10
Ecuador	38	18.3	12.0	59.9	18.0	477	179.7	125.8	3336
India	126	46.7	610.4	3052.1	915.6	7267	9156.2	6409.3	50868
Indonesia	1,220	480	126.6	632.9	189.9	156	1898.7	1329.1	1089
Madagascar	367	121	0.8	4.2	1.3	3	12.6	8.8	24
Malaysia	233	118	66.2	331.1	99.3	426	993.3	695.3	2984
Mexico	262	66	131.0	654.9	196.5	750	1964.6	1375.2	5249
Peru	211	99.6	16.8	84.2	25.3	120	252.6	176.8	838
Philippines	55	21.6	28.8	144.1	43.2	790	432.2	302.5	5531
Papua New Guinea	114	65.5	1.7	8.6	2.6	23	25.8	18.1	159
Venezuela	112	36.4	50.5	252.6	75.8	676	757.7	530.4	4735
<b>Total</b>	<b>7,284</b>	<b>2,771</b>	<b>1,214</b>	<b>6,068</b>	<b>1,820</b>		<b>18,204</b>	<b>12,742</b>	

<sup>a</sup> Based on the 17 megadiverse countries identified by Mittermeier, R.A., Robles-Gil, P., Mittermeier, C.G. (Eds) 1997. Megadiversity. Earth's Biologically Wealthiest Nations. CEMEX/Agrupación Sierra Madre, Mexico City. The other four countries are Australia, China, South Africa and the United States. This list is used to set conservation priorities internationally, see <https://www.worldatlas.com/articles/ecologically-megadiverse-countries-of-the-world.html>

<sup>b</sup> Global Forest Watch. 2019. World Resources Institute. Accessed on (12 November 2019). [www.globalforestwatch.org](http://www.globalforestwatch.org). In 2018 total tree cover loss was 24,800 kha and CO<sub>2</sub> emissions were 37,100 Mt. Thus, the above 17 countries contributed 29% of global annual tree cover loss and 7% of global CO<sub>2</sub> emissions.

<sup>c</sup> Boden, T.A., Marland, G., and Andres, R.J. (2017). National CO<sub>2</sub> Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2014, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, doi 10.3334/CDIAC/00001\_V2017. [https://cdiac.ess-dive.lbl.gov/trends/emis/meth\\_reg.html](https://cdiac.ess-dive.lbl.gov/trends/emis/meth_reg.html) Accessed on (12 November 2019).

<sup>d</sup> Assumes a carbon tax of \$5/tC and 30% is allocated to natural climate solutions (NCS).

<sup>e</sup> Assumes a carbon tax of \$15/tC and 70% is allocated to natural climate solutions (NCS).

<sup>f</sup> Estimated by dividing the amount of revenues available for natural climate solutions (NCS) by the amount of annual forest loss (2018) in a country. This estimate gives an indication of the amount of carbon tax revenues available to each country for combating each hectare of forest loss with natural climate solutions.

The above table is based on the 17 megadiverse countries identified by Mittermeier et al.<sup>1</sup> Thirteen of these countries are located predominantly in tropical regions. The other four countries are Australia, China, South Africa and the United States. Although originally published in 1997, this list is still widely used to set biodiversity conservation priorities internationally.<sup>2</sup>

Forest loss area and emissions for the thirteen tropical megadiverse countries are for the latest available year (2018) as estimated by Global Forest Watch of the World Resources Institute.<sup>3</sup> In 2018 total forest loss was 7,284 kha and CO<sub>2</sub> emissions were 37,100 Mt.

Fossil fuel CO<sub>2</sub> emissions for the thirteen tropical megadiverse countries are for the latest available year (2014) as estimated by Oak Ridge National Laboratory, U.S. Department of Energy.<sup>4</sup>

Policy A assumes that all thirteen countries in Table 1 adopt a \$5 per tonne of carbon (tC) tax on all CO<sub>2</sub> emissions from fossil fuels, and that 30% of these revenues are allocated to fund natural climate solutions as defined by Griscom et al.<sup>5</sup> This tropical carbon tax follows closely Colombia's current policy.

In 2016, Colombia implemented a carbon tax on companies producing fossil fuels for the domestic market and direct importers of these fuels. Colombia's carbon tax yielded revenues of \$148 million in 2017 and \$91 million in 2018.<sup>6</sup> The Colombian tax in 2019 averaged \$5 per tCO<sub>2</sub> or around \$18.4 per tC.<sup>7</sup> However, this tax is not levied on all fossil fuels, but is restricted to gasoline, kerosene, jet fuel, diesel and fuel oil.<sup>8</sup> Natural gas is included but only for industrial use in refining of hydrocarbons and petrochemicals. Liquid gas from oil is included but only for sales for industrial uses. Coal use and domestic natural gas use are not taxed.

As shown in Table 1, for the purposes of estimating Policy A, we assume that Colombia's carbon tax on selective fossil fuels translates into an effective tax of \$5 per tC on all fossil fuel fuels. As shown in the table, this yields total annual revenues of around \$115 million, which is in the range of the revenues of \$148 million in 2017 and \$91 million in 2018 earned from Colombia's carbon tax.<sup>6</sup>

Colombia's carbon tax revenues are allocated to the Colombian Peace Fund (Fondo Colombia en Paz) from which 25% is used to manage coastal erosion, reduce and monitor deforestation, conserve water sources, protect strategic ecosystems, and combat climate change. A further 5% is used to strengthen Colombia's National Protected Areas System.<sup>6</sup> In effect, this means that approximately 30% of the total revenue is allocated to natural climate solutions, which is our assumption under Policy A.

Policy B assumes that all thirteen countries in Table 1 adopt a more ambitious \$15 per tonne of carbon (tC) tax on all CO<sub>2</sub> emissions from fossil fuels, and that 70% of these revenues are allocated to fund natural climate solutions.

For both Policy A and Policy B we provide an estimate of the amount of carbon tax revenues available to each country for combating each hectare of forest loss with natural climate solutions (NCS), under the column headed NCS \$ ha<sup>-1</sup> forest loss. This estimate is obtained by dividing the amount of revenues available for natural climate solutions (NCS) by the amount of annual forest loss (2018) in a country. This estimate is a measure of how much it would cost to restore or conserve per hectare of forest that is currently lost through deforestation in each country. A lower/higher number means that there is less/more money available per ha of current forest loss. This column should not be interpreted as cost estimates of the quantity of forest that could be saved or restored.

### Supplementary References

<sup>1</sup>Mittermeier, R.A., Robles-Gil, P., Mittermeier, C.G., eds. Megadiversity. Earth's Biologically Wealthiest Nations. CEMEX/Agrupación Sierra Madre, Mexico City (1997).

<sup>2</sup>Pariona, A. The world's 17 megadiverse countries. Worldatlas <https://www.worldatlas.com/articles/ecologically-megadiverse-countries-of-the-world.html> Accessed on (12 November 2019).

<sup>3</sup> Global Forest Watch. 2019. World Resources Institute. [www.globalforestwatch.org](http://www.globalforestwatch.org). Accessed on (12 November 2019).

<sup>4</sup> Boden, T.A., Marland, G., Andres, R.J. 2017. *Global, Regional, and National Fossil-Fuel CO<sub>2</sub> Emissions*, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy (2017), doi 10.3334/CDIAC/00001\_V2017. [https://cdiac.ess-dive.lbl.gov/trends/emis/overview\\_2014.html](https://cdiac.ess-dive.lbl.gov/trends/emis/overview_2014.html) Accessed on (12 November 2019).

<sup>5</sup>Griscom, B.W., Adams, J., Ellis, P.W. et al. Natural climate solutions. *Proceedings of the National Academy of Sciences* **114**, 11645-11650 (2017) <https://doi.org/10.1073/pnas.1710465114>

<sup>6</sup>Colombian Tax and National Customs Department (DIAN). Statistics on Annual Revenue by Tax Type 1970 – 2019 (In Spanish). <https://www.dian.gov.co/dian/cifras/Paginas/EstadisticasRecaudo.aspx> Accessed on (12 November 2019)

<sup>7</sup>Colombian Tax and National Customs Department (DIAN) (2019). Resolution Number 000009 (in Spanish). <https://www.dian.gov.co/normatividad/Normatividad/Resolución%20000009%20de%2028-01-2019.pdf>

<sup>8</sup>Ministry of Environment and Sustainable Development, Colombia (2019). ABC: Main questions about national carbon tax and request for exemption through carbon neutrality (in Spanish). [http://www.minambiente.gov.co/images/abc\\_carbono\\_final29ago.pdf](http://www.minambiente.gov.co/images/abc_carbono_final29ago.pdf)