

2019 **SCIENTISTS URGE ENDORSEMENT** Aug **OF CALIFORNIA TROPICAL FOREST** **STANDARD**

Daniel Nepstad | Executive Director & President

*Earth Innovation Institute is coordinating this letter from **Scientists in Support of the California Tropical Forest Standard**. It will be submitted to the California Air Resources Board in advance of a September 19 [public meeting](#) to consider endorsement of the California Tropical Forest Standard.*

Are you a scientist interested in joining this Letter? Write to Dan Nepstad (dnepstad@earthinnovation.org) and Jonah Busch (jbusch@earthinnovation.org). *If you're not a scientist but still support the California Tropical Forest Standard you can submit a public comment to Air Resources Board [here](#) or [here](#).*

We are scientists—ecologists, economists, anthropologists, geographers, and climatologists. We are all directly involved with research to better understand climate change and to identify the best ways to avoid its most dangerous impacts. Many of us have spent decades working in the Tropics.

We include 10 lead authors of the Intergovernmental Panel on Climate Change; 7 members of the United States National Academy of Sciences; 7 Fellows of the California Academy of Sciences; 1 member of the European Academy of Sciences; 1 member of the Australia National Academy of Sciences; 4 current or former Directors General of the Center for International Forestry Research; and 2 MacArthur “Genius Grant” fellows. We have collectively authored hundreds of articles in Science, Nature, and other top scientific journals.

We are writing to strongly urge the California Air Resources Board to endorse the California Tropical Forest Standard (CTFS). We believe that California has a unique opportunity to leverage its global leadership on climate policy to advance a broad and inclusive agenda to address climate change by protecting tropical forests at scale.

The message we convey is this: slowing the loss and speeding the recovery of tropical forests is a critical part of any successful global strategy for minimizing the negative impacts of climate change. The CTFS is an important step towards unlocking this potential.

1. The best science shows us that tropical forests could help avoid the most dangerous impacts of climate change.¹⁻³

These carbon- and species-rich ecosystems could deliver 25 to 30% of the carbon emissions reductions needed by 2030 to avoid dangerous climate change.³ Slowing the deforestation and degradation of tropical forests, the source of as much as one fifth of global emissions,⁴⁻¹⁵ while allowing damaged forests to recover¹⁶⁻¹⁹ is one of the most cost-effective, near-term steps towards a zero net carbon budget globally.²⁰⁻²⁷

2. The CTFS could help unlock this potential.

The CTFS would establish a very high bar of methodological rigor, transparency and accountability for tropical forest jurisdictions—states, provinces, counties and even nations—that are taking steps to reduce deforestation and advance low-emission development. Given California’s global leadership on climate change solutions and the depth of the analyses and public consultation that went into developing the Standard, we believe that the CTFS would be adopted by other programs under development by governments and industries to support the transition of tropical forest jurisdictions to equitable low-emission development. The Standard is also likely to be used by tropical forest jurisdictions themselves.

3. The importance of the CTFS goes beyond offsets and REDD+.

The CTFS was deliberately developed as an alternative to project-based REDD+ and it reflects a recognition that one of the most promising pathways to achieve emissions reductions at scale in tropical forest regions is to encourage the governments of jurisdictions to partner with civil society, the private sector, and indigenous peoples and local communities to develop durable programs for low emissions development. While the standard could eventually inform efforts to recognize the emissions reductions achieved by tropical forest jurisdictions in existing and emerging “pay-for-performance” programs, including implementation of California’s international offset provision, its value goes beyond this purpose.

The Standard is focused on *jurisdictional*²⁸⁻³¹, or “sector-wide”, strategies for slowing the loss of tropical forests while improving the livelihoods and participation of forest communities within a broader transition to low-emission development. Jurisdictional strategies seek systemic solutions to deforestation, inadequate recognition of land rights, and other issues across entire political geographies—states and provinces—and are much less susceptible to leakage and dubious carbon accounting than some of the project-based examples that have been cited by others.

4. The CTFS already reflects important progress made in fostering stronger partnerships between tropical forest governments and Indigenous Peoples.

One of the highlights of the Global Climate Action Summit in San Francisco last September was the announcement of “[Guiding Principles for Collaboration and Partnership between Subnational Governments, Indigenous Peoples and Local Communities](#).” State and provincial governments that are members of the Governors’ Climate and Forests Task Force endorsed these principles and shook hands with the democratically-elected leaders of key Indigenous Peoples organizations in Indonesia (AMAN), Central America and Mexico (AMPB) and the Amazon (COICA). In all, 35 governments, 18 Indigenous Peoples organizations, and 17 environmental NGOs endorsed these Principles, which have now been included in the CTFS.

These partnerships are already happening, as has been [documented](#) for the State of Acre, in the Brazilian Amazon, which has a 20-year partnership between the state government and the Indigenous Peoples who reside in the state.³²

Conclusion: To unlock the potential of tropical forests as a climate change solution, it is urgent that the California Tropical Forest Standard be endorsed. If endorsement is postponed, an important opportunity will be lost to send the signal that California, in its role as a global leader of climate change solutions, recognizes and supports bold efforts to address climate change by slowing the loss and speeding the recovery of tropical forests.

Signatories as of Aug. 26, 2019

Alphabetical by last name:

Dr. Ryan Abman, Assistant Professor of Economics, San Diego State University

Dr. Arun Agrawal, Professor, School of Environment and Sustainability, University of Michigan; Editor-in-Chief, World Development

Dr. Jennifer Alix-Garcia, Department Head and Professor, Applied Economics, Oregon State University

Dr. Angélica M. Almeyda Zambrano, Assistant Professor, Spatial Ecology and Conservation, University of Florida

Kenneth Andrasko, President and CEO, AltaVerde Consulting, expert in climate change policy, forest carbon finance and low emissions development, lead author, IPCC Assessment reports (2) and IPCC contributing author

Dr. Arild Angelsen, Economist, REDD+ expert, Norwegian University of Life Sciences

Dr. Juan Ardila, Geo-informatics and Earth observation, Earth Innovation Institute

Dr. Nigel Asquith, Zoologist, Natura Foundation, Bolivia

Dr. Juliano Assunção, Associate Professor of Economics, Pontifical Catholic University of Rio de Janeiro

Dr. Alessandro Baccini, Remote Sensing Expert, Associate Scientist, Woods Hole Research Institute; Research Professor, Boston University

Dr. Simone Carolina Bauch, Environmental economist, climate change consultant for UNDP, FAO and GCF

Dr. Jules Bayala, Principal Scientist, Sahel Ecosystems, World Agroforestry Centre

Dr. Allen Blackman, Nonresident Fellow, Resources for the Future

Dr. Rizaldi Boer, Executive Director, Center for Climate Risk and Opportunity Management, Bogor Agricultural University, Indonesia

Dr. Paulo Brando, Tropical/global ecologist and forest fire expert, Assistant Professor, University of California, Irvine

Dr. Katrina Brandon, Ecologist and tropical forest expert

Dr. Eben Broadbent, Assistant Professor, Spatial Ecology and Conservation, University of Florida

Dr. Foster Brown, Environmental Scientist, Woods Hole Research Center and the Federal University of Acre, Brazil

Dr. Zuzana Burivalova, Assistant Professor, Nelson Institute for Environmental Studies & Department of Forest & Wildlife Ecology, University of Wisconsin-Madison

Dr. Jonah Busch, Environmental economist and tropical forest expert, Chief Economist, Earth Innovation Institute

Dr. Robert Buschbacher, Associate in Tropical Forestry, University of Florida

Dr. Kimberly Carlson, Assistant Professor, Department of Natural Resources and Environmental Management, University of Hawai'i Mānoa

Dr. L. Roman Carrasco, Conservation Scientist, Associate Professor, National University of Singapore

Dr. Jill Caviglia-Harris, Professor of Economics, Economics and Finance Department, Environmental Studies Department, Salisbury University, Maryland

Dr. Jeff Chambers, Forest Ecosystem Ecologist, Professor of Geography, University of California, Berkeley

Dr. Robin Chazdon, Professor Emerita, Ecologist, University of Connecticut

Dr. Stefano Crema, Chief Application Research Officer, Clark Labs, Clark University

Dr. Gretchen C. Daily, Bing Professor of Environmental Science, Dept. of Biology and Woods Institute, Stanford University (Member, National Academy of Sciences, USA; Fellow, California Academy of Sciences)

Dr. Ruth Defries, Sustainability Science, Columbia University (Member, National Academy of Sciences, USA; Fellow, California Academy of Sciences; Lead Author, IPCC AR4; MacArthur Award recipient)

Dr. Maria DiGiano, Environmental anthropologist, Earth Innovation Institute

Dr. Amy Duchelle, Ecologist and REDD+ expert, Center for International Forestry Research (CIFOR)

Dr. Phil Duffy, Climatologist, Executive Director, Woods Hole Research Center

Dr. Robert A. Dull, Associate Professor and Chair, Department of Earth & Environmental Sciences, California Lutheran University

Dr. Joanna Durbin, Ecologist and REDD+ Safeguards Expert, Conservation International

Dr. Chris Field, Director, Stanford Woods Institute for the Environment, Stanford University (Member, National Academy of Sciences, USA; IPCC Co-Chair and Lead Author)

Dr. Brendan Fisher, Director - Environmental Program, Rubenstein School of Environment and Natural Resources, University of Vermont

Dr. Jonathan Foley, Executive Director, Project Drawdown (Fellow, California Academy of Sciences)

Dr. Jianbang Gan, Professor, Ecosystem Science and Management, Texas A&M University

Dr. Rachael Garrett, Assistant Professor of Environmental Policy, ETH Zurich

Dr. Holly Gibbs, Associate Professor, Department of Geography and Nelson Institute for Environmental Studies, University of Wisconsin-Madison

Dr. Javier Godar, Senior Researcher, Stockholm Environment Institute

Dr. Scott Goetz, Professor, School of Informatics, Computing and Cyber Systems, Northern Arizona University

Dr. Hedley Grantham, Director, Conservation Planning, Wildlife Conservation Society

Dr. Bronson Griscom, Senior Director, Natural Climate Solutions, Conservation International

Dr. Steven P. Hamburg, Forest Ecologist, Chief Scientist, Environmental Defense Fund (Former IPCC Lead Author)

Dr. Lee Hannah, Senior Research Fellow, Climate Change Biology, Conservation International, Adjunct Faculty, Bren School of Environmental Science and Management, University of California, Santa Barbara

Dr. Bård Harstad, Professor in Economics, University of Oslo

Dr. John Harte, Professor of Ecosystem Sciences, Energy and Resources Group, University of California, Berkeley (Fellow, California Academy of Sciences)

Dr. Kristell Hergoualc'h, Expert in ecosystem function, Center for International Forestry Research (CIFOR)

Dr. Tom Hertel, Distinguished Professor of Agricultural Economics, Purdue University, Distinguished Fellow AAAS and AAEA, Past President AAEA

Dr. Laura Hess, Associate Researcher, University of California, Santa Barbara

Dr. John Holdren, Teresa and John Heinz Professor of Environmental Policy, Kennedy School of Government, Harvard University (former Director of the White House Office of Science and Technology Policy; Member, National Academy of Sciences; Fellow, California Academy of Sciences)

Dr. Amy Ickowitz, Senior Scientist, Sustainable Landscapes and Livelihoods, Center for International Forestry Research (CIFOR)

Dr. Julia Jones, Professor of Conservation Science, Bangor University

Dr. David Kaimowitz, Former Director General, Center for International Forestry Research

Dr. Daniel Kammen, Professor of Energy, Energy and Resources Group, University of California, Berkeley

Dr. Krithi Karanth, Executive Director, Centre for Wildlife Studies, India; Adjunct Assistant Professor, Nicholas School of the Environment, Duke University

Dr. Torsten Krause, Assistant Professor in Sustainability Science, Lund University Centre for Sustainability Studies, Sweden

Dr. Eric Lambin, Foreign Associate of the National Academy of Sciences, USA, Academia Europaea, European Academy of Sciences, Académie Royale des sciences, des lettres & des beaux-arts de Belgique, 2014 Laureate Volvo Environment Prize, 2019 Laureate Blue Planet Prize

Dr. William Laurance, Ecologist, Tropical Forest Expert, Professor, James Cook University, Cairns, Australia; Member, National Academy of Science

Dr. Beverly Law, Professor, Global Change Biology & Terrestrial Systems Science, Oregon State University (AGU Fellow, Former Chair of the Global Terrestrial Observing System - Terrestrial Carbon Observations and Chair of the AmeriFlux network of sites)

Dr. Deborah Lawrence, Professor of Environmental Science, University of Virginia; Guggenheim Fellow

Dr. Jim Leape, Senior Fellow, Stanford Woods Center for the Environment; Former Director General, WWF International

Dr. Thomas Lovejoy, Ecologist, Amazon specialist, United Nations Foundation

Dr. Ruben Lubowski, Chief Natural Resource Economist, Environmental Defense Fund

Dr. Marcia Macedo, Tropical Ecology and Land Use Specialist, Associate Scientist, Woods Hole Research Center

Dr. Katharine Mach, Associate Professor, Rosenstiel School of Marine and Atmospheric Science, University of Miami

Dr. Christopher Martius, Team Leader Climate Change, Center for International Forestry Research

Dr. David Marvin, Remote Sensing Expert & Tropical Ecologist, Co-Founder & CEO, Salo Sciences Inc., San Francisco, California

Dr. Eskil Mattsson, Senior Researcher, IVL Swedish Environmental Research Institute, Sweden

Dr. David G. McGrath, Geographer and Amazon specialist, Senior Scientist, Earth Innovation Institute

Dr. Jeff Milder, Ecologist, Direct of Global Programs, Rainforest Alliance & Adjunct Professor, Cornell University

Dr. William R. Moomaw, Emeritus Professor, International Environmental Policy, The Fletcher School and Co-director Global Development and Environment institute, Tufts University (IPCC lead author)

Dr. Katrina Mullan, Associate Professor of Economics, University of Montana

Dr. Harini Nagendra, Professor of Sustainability, Azim Premji University, India, (IPCC Lead Author)

Dr. Robert Nasi, Director General, Center for International Forestry Research (CIFOR)

Dr. Ståle Navrud, Professor of Environmental and Resource Economics, Norwegian University of Life Sciences (Review Editor, IPCC AR5)

Dr. Christopher Neill, Tropical Ecologist, Senior Scientist, Woods Hole Research Center

Dr. Daniel Nepstad, Ecologist and Amazon specialist, President, Earth Innovation Institute (IPCC Lead Author)

Dr. Peter Newton, Assistant Professor, Environmental Studies Program, University of Colorado

Dr. Michael Obersteiner, Ecosystem Modeler, Program Director, IIASA

Dr. Madelene Ostwald, Associate Professor, University of Gothenburg & Chalmers University of Technology, Sweden

Dr. Charles Palmer, Associate Professor of Environment & Development, Department of Geography & Environment, London School of Economics

Dr. Steven Panfil, Senior Director, Project Development and Implementation, CI Green Climate Fund Agency, Conservation International

Dr. Martin Persson, Associate Professor, Department of Energy & Environment, Chalmers University of Technology

Dr. Stephen Perz, Professor of Sociology, University of Florida

Dr. Stuart Pimm, Doris Duke Chair of Conservation, Duke University, and President, Saving Nature

Dr. Francis Putz, Ecologist, Distinguished Professor, University of Florida

Dr. Peter Raven, President Emeritus, Missouri Botanical Garden (Member, National Academy of Sciences, USA; ; Fellow, California Academy of Sciences)

Dr. William J. Ripple, Distinguished Professor of Ecology, Oregon State University

Dr. Claudia Romero, Courtesy Assistant Professor and Researcher, Department of Biology, University of Florida

Dr. Knut Einar Rosendahl, Professor, Economics, Norwegian University of Life Sciences

Dr. M. Sanjayan, Chief Executive Officer, Conservation International

Dr. Bill Savedoff, Development economist, Senior Fellow, Center for Global Development

Dr. Jeffrey Sayer, Professor of Tropical Forest Conservation, University of British Columbia; Founding Director General, Center for International Forestry Research

Dr. Stephan Schwartzman, Anthropologist, Amazon specialist, Environmental Defense Fund

Dr. Silvia Secchi, Associate Professor, Geographical and Sustainability Sciences & Public Policy, University of Iowa

Frances Seymour, Former Director General, Center for International Forestry Research

Dr. Erin Sills, Professor, Forestry and Environmental Resources, North Carolina State University

Dr. Laura Snook, Honorary fellow, Bioversity International

Dr. Marc Steininger, Remote sensing expert, Department of Geographical Sciences, University of Maryland, College Park, MD

Dr. Claudia Stickler, Geographer and political ecologist, Earth Innovation Institute

Dr. Dietmar Stoian, Lead Scientist, World Agroforestry (ICRAF)

Dr. Bernie Tershy, Adjunct Professor, Ecology & Evolutionary Biology, University of California, Santa Cruz

Dr. Will Turner, Climate Science and Forest Conservation expert, Senior Scientist, Conservation International

Dr. Lou Verchot, Research Leader for Land Restoration, International Center for Tropical Agriculture, Cali, Colombia, IPCC Lead and Coordinating Lead Author

Dr. Reynaldo Victoria, Hydrologist, Amazon specialist, Universidade de São Paulo, Brazil (Emeritus)

Dr. Jeffrey Vincent, Professor, Forest Economics and Management, Nicholas School of the Environment, Duke University.

Dr. Wayne Walker, Remote Sensing Expert, Associate Scientist and Director of Carbon Program, Woods Hole Research Center

Dr. Matthew Warren, Tropical Forest Ecologist, Research Associate, Earth Innovation Institute

Dr. Edward Webb, California native, concerned citizen and environmental scientist. Associate Professor, Department of Biological Sciences, National University of Singapore

Dr. Diana Weinhold, Associate Professor, Development Economics, London School of Economics

Dr. Paul West, Co-Director & Lead Scientist, Global Landscapes Initiative, Institute on the Environment, University of Minnesota

Dr. David S. Wilcove, Professor of Ecology, Evolutionary Biology and Public Affairs, Princeton University

Dr. Michael Wolosin, Ecologist and Tropical Deforestation Expert, Forest Climate Analytics

Dr. George Woodwell, Founder, Senior Scientist, Woods Hole Research Center (Member, National Academy of Sciences, USA)

Dr. Sven Wunder, Natural Resource Economist, Principal Scientist, European Forest Institute

Dr. Erika Zavaleta, Howard Hughes Medical Institute Professor, Ecology and Evolutionary Biology, University of California, Santa Cruz (Fellow, California Academy of Sciences)

References Cited in the Letter

- 1. Houghton, R.A., Byers, B., Nassikas, A.A., 2015. A role for tropical forests in stabilizing atmospheric CO₂. *Nature Climate Change* 5, 1022–1023. <https://doi.org/10.1038/nclimate2869>
- 2. Seymour, F., Busch, J., 2016. Why forests? Why now? The science, economics, and politics of tropical forests and climate change. Center for Global Development, Washington DC.
- 3. Griscom, B.W., Adams, J., Ellis, P.W., Houghton, R.A., Lomax, G., Miteva, D.A., Schlesinger, W.H., Shoch, D., Siikamäki, J.V., Smith, P., Woodbury, P., Zganjar, C., Blackman, A., Campari, J., Conant, R.T., Delgado, C., Elias, P., Gopalakrishna, T., Hamsik, M.R., Herrero, M., Kiesecker, J., Landis, E., Laestadius, L., Leavitt, S.M., Minnemeyer, S., Polasky, S., Potapov, P., Putz, F.E., Sanderman, J., Silvius, M., Wollenberg, E., Fargione, J., 2017. Natural climate solutions. *Proceedings of the National Academy of Sciences* 114, 11645–11650. <https://doi.org/10.1073/pnas.1710465114>
- 4. Pan, Y., Birdsey, R.A., Fang, J., Houghton, R., Kauppi, P.E., Kurz, W.A., Phillips, O.L., Shvidenko, A., Lewis, S.L., Canadell, J.G., Ciais, P., Jackson, R.B., Pacala, S.W., McGuire, A.D., Piao, S., Rautiainen, A., Sitch, S., Hayes, D., 2011. A Large and Persistent Carbon Sink in the World's Forests. *Science* 333, 988–993. <https://doi.org/10.1126/science.1201609>
- 5. Baccini, A., Goetz, S.J., Walker, W.S., Laporte, N.T., Sun, M., Sulla-Menashe, D., Hackler, J., Beck, P.S.A., Dubayah, R., Friedl, M.A., Samanta, S., Houghton, R.A., 2012. Estimated carbon dioxide emissions

from tropical deforestation improved by carbon-density maps. *Nature Climate Change* 2, 182–185. <https://doi.org/10.1038/nclimate1354>

- 6. Harris, N.L., Brown, S., Hagen, S.C., Saatchi, S.S., Petrova, S., Salas, W., Hansen, M.C., Potapov, P.V., Lotsch, A., 2012. Baseline Map of Carbon Emissions from Deforestation in Tropical Regions. *Science* 336, 1573–1576. <https://doi.org/10.1126/science.1217962>
- 7. Achard, F., Beuchle, R., Mayaux, P., Stibig, H.-J., Bodart, C., Brink, A., Carboni, S., Desclée, B., Donnay, F., Eva, H.D., Lupi, A., Raši, R., Seliger, R., Simonetti, D., 2014. Determination of tropical deforestation rates and related carbon losses from 1990 to 2010. *Global Change Biology* 20, 2540–2554. <https://doi.org/10.1111/gcb.12605>
- 8. Grace, J., Mitchard, E., Gloor, E., 2014. Perturbations in the carbon budget of the tropics. *Global Change Biology* 20, 3238–3255. <https://doi.org/10.1111/gcb.12600>
- 9. Tubiello, F.N., Salvatore, M., Ferrara, A.F., House, J., Federici, S., Rossi, S., Biancalani, R., Condor Golec, R.D., Jacobs, H., Flammini, A., Prosperi, P., Cardenas-Galindo, P., Schmidhuber, J., Sanz Sanchez, M.J., Srivastava, N., Smith, P., 2015. The Contribution of Agriculture, Forestry and other Land Use activities to Global Warming, 1990-2012. *Global Change Biology* 21, 2655–2660. <https://doi.org/10.1111/gcb.12865>
- 10. Liu, Y.Y., van Dijk, A.I.J.M., de Jeu, R.A.M., Canadell, J.G., McCabe, M.F., Evans, J.P., Wang, G., 2015. Recent reversal in loss of global terrestrial biomass. *Nature Climate Change* 5, 470–474. <https://doi.org/10.1038/nclimate2581>
- 11. Zarin, D.J., Harris, N.L., Baccini, A., Aksenov, D., Hansen, M.C., Azevedo-Ramos, C., Azevedo, T., Margono, B.A., Alencar, A.C., Gabris, C., Allegretti, A., Potapov, P., Farina, M., Walker, W.S., Shevade, V.S., Loboda, T.V., Turubanova, S., Tyukavina, A., 2016. Can carbon emissions from tropical deforestation drop by 50% in 5 years? *Global Change Biology* 22, 1336–1347. <https://doi.org/10.1111/gcb.13153>
- 12. Smith, P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsidig, E.A., Haberl, H., Harper, R., House, J., Jafari, M., Masera, O., Mbow, C., Ravindranath, N.H., Rice, C.W., Robledo Abad, C., Romanovskaya, A., Sperling, F., Tubiello, F., 2014. Agriculture, Forestry and Other Land Use (AFOLU), in: Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Baum, I., Brunner, S., Eickemeier, P., Kriemann, B., Savolainen, J., Schlömer, S., von Stechow, C., Zwickel, T., Minx, J.C. (Eds.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York,

NY, USA.

- 13. Silver, W.L., Ostertag, R., Lugo, A.E., 2000. The Potential for Carbon Sequestration Through Reforestation of Abandoned Tropical Agricultural and Pasture Lands. *Restoration Ecology* 8, 394–407.
<https://doi.org/10.1046/j.1526-100x.2000.80054.x>
- 14. Gilroy, J.J., Woodcock, P., Edwards, F.A., Wheeler, C., Baptiste, B.L.G., Medina Uribe, C.A., Haugaasen, T., Edwards, D.P., 2014. Cheap carbon and biodiversity co-benefits from forest regeneration in a hotspot of endemism. *Nature Climate Change* 4, 503–507.
<https://doi.org/10.1038/nclimate2200>
- 15. Olsson, L., Barbosa, H., et al. 2019. IPCC Special Report on Climate Change and Land. Chapter 4: Land Degradation. Intergovernmental Panel on Climate Change, Geneva, Switzerland.
- 16. Chazdon, R.L., Guariguata, M.R., 2016. Natural regeneration as a tool for large-scale forest restoration in the tropics: prospects and challenges. *Biotropica* 48, 716–730. <https://doi.org/10.1111/btp.12381>
- 17. Hawes, M., 2018. Planting carbon storage. *Nature Climate Change* 8, 556–558. <https://doi.org/10.1038/s41558-018-0214-x>
- 18. Bastin, J.F., Finegold, Y., Garcia, C., Mollicone, D., Rezende, M., Routh, D., Zohner, C.M., Crowther, T.W. 2019. The global tree restoration potential. *Science* 365, 76-79.
- 19. Brancalion, P.H.S., et al. 2019. Global restoration opportunities in tropical rainforest landscapes. *Science Advances*, 5 DOI: 10.1126/sciadv.aav3223
- 20. Kindermann, G., Obersteiner, M., Sohngen, B., Sathaye, J., Andrasko, K., Rametsteiner, E., Schlamadinger, B., Wunder, S., Beach, R., 2008. Global cost estimates of reducing carbon emissions through avoided deforestation. *Proceedings of the National Academy of Sciences* 105, 10302–10307. <https://doi.org/10.1073/pnas.0710616105>
- 21. Strassburg, B., Turner, R.K., Fisher, B., Schaeffer, R., Lovett, A., 2009. Reducing emissions from deforestation—The “combined incentives” mechanism and empirical simulations. *Global Environmental Change* 19, 265–278. <https://doi.org/10.1016/j.gloenvcha.2008.11.004>
- 22. Coren, M.J., Streck, C., Madeira, E.M., 2011. Estimated supply of RED credits 2011–2035. *Climate Policy* 11, 1272–1288.
<https://doi.org/10.1080/14693062.2011.579318>
- 23. Busch, J., Engelmann, J., 2017. Cost-effectiveness of reducing emissions from tropical deforestation, 2016–2050. *Environmental Research Letters* 13, 015001. <https://doi.org/10.1088/1748-9326/aa907c>
- 24. Busch, J.B., Engelmann, J., Cook-Patton, S., Griscom, B., Kroeger, T., Possingham, H., Shyamsundar, P. (2019). “Low-Cost Opportunities for

Carbon Dioxide Removal Through Tropical Reforestation" *Nature Climate Change*, 9:463-466.

- 25. Busch J et al.2012. Structuring economic incentives to reduce emissions from deforestation within Indonesia. *Proceedings of the National Academy of Sciences* 109(4):1062-1067.
- 26. Fuss, S., Lamb, W.F., Callaghan, M.W., Hilaire, J., Creutzig, F., Amann, T., Beringer, T., de Oliveira Garcia, W., Hartmann, J., Khanna, T., Luderer, G., Nemet, G.F., Rogelj, J., Smith, P., Vicente, J.L.V., Wilcox, J., del Mar Zamora Dominguez, M., Minx, J.C., 2018. Negative emissions—Part 2: Costs, potentials and side effects. *Environmental Research Letters* 13, 063002. <https://doi.org/10.1088/1748-9326/aabf9f>
- 27. Edwards, D.P., Fisher, B., Boyd, E., 2010. Protecting degraded rainforests: enhancement of forest carbon stocks under REDD+: Enhancing forest carbon with REDD+. *Conservation Letters* 3, 313–316. <https://doi.org/10.1111/j.1755-263X.2010.00143.x>
- 28. Nepstad, D., Irawan, S., Bezerra, T., Boyd, W., Stickler, C., Shimada, J., Carvalho, O., MacIntyre, K., Dohong, A., Alencar, A., Azevedo, A., Tepper, D., Lowery, S., 2013. More food, more forests, fewer emissions, better livelihoods: linking REDD+, sustainable supply chains and domestic policy in Brazil, Indonesia and Colombia. *Carbon Management* 4, 639–658. <https://doi.org/10.4155/cmt.13.65>
- 29. Nepstad, D., McGrath, D., Stickler, C., Alencar, A., Azevedo, A., Swette, B., Bezerra, T., DiGiano, M., Shimada, J., Seroa da Motta, R., Armijo, E., Castello, L., Brando, P., Hansen, M.C., McGrath-Horn, M., Carvalho, O., Hess, L., 2014. Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science* 344, 1118–1123. <https://doi.org/10.1126/science.1248525>
- 30. Boyd, W., Stickler, C., Duchelle, A.E., Seymour, F., Nepstad, D., Bahar, N.H.A., Rodriguez WArD, D., 2018. Jurisdictional Approaches to REDD+ and Low Emissions Development: Progress and Prospects. Working Paper. Presented at the Oslo Tropical Forest Forum, Oslo, World Resources Institute, Washington, DC.
- 31. Stickler, CM et al. 2018. The State of Jurisdictional Sustainability. San Francisco, USA: Earth Innovation Institute/Bogor, Indonesia: Center for International Forestry Research/Boulder, USA: Governors' Climate and Forests Task Force Secretariat.
- 32. DiGiano, M., Mendoza, E., Ochoa, M.L., Ardila, J, Olivieria de Lima, F., Nepstad, D. 2018. The twenty –year-old partnership between indigenous peoples and the Government of Acre, Brazil. Earth Innovation Institute, Collaboration for Climate series, San Francisco USA.